MASTER

LEGISLATIVE HISTORY

POWERPLANT AND INDUSTRIAL FUEL USE ACT PL 95-620

1978

VOLUME 11

**UNITED STATES DEPARTMENT
OF ENERGY**

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Chapter 4

House of Representatives

(Cont'd)

AFTER RECESS

[The subcommittee reconvened at 2:30 p.m., Hon. John D. Dingell presiding.]

Mr. DINGELL. The subcommittee will come to order.

This is a continuation of the hearings of the subcommittee on the National Energy Act, title I, part F, amendments to the Energy Supply and Environmental Coordination Act.

Our panel this afternoon is a panel on the impact of conversion: Mr. William B. Marx, Mr. Daniel F. Twomey, Mr. Loren V. Forman, and Mr. James Price.

Gentlemen, we have done you an unkindness by having our panel this morning persist rather longer than was our intention. I express to you our apologies in the hope that we have not inconvenienced you.

Gentlemen, would you please, starting on your left, and on my right, identify yourselves each, please.

STATEMENTS OF JAMES U. PRICE, DIRECTOR OF CORPORATE ENGINEERING, M. LOWENSTEIN & SONS, AND CHAIRMAN, FINISHERS ENERGY CONSERVATION SUBCOMMITTEE, AMERICAN TEXTILE MANUFACTURERS INSTITUTE; ACCOMPANIED BY JAMES A. MORRISSEY, SECRETARY, ATMI ENERGY POLICY COMMITTEE; LOREN V. FORMAN, VICE PRESIDENT, ENVIRONMENTAL RESOURCES, SCOTT PAPER COMPANY, ON BEHALF OF THE AMERICAN PAPER INSTITUTE; DANIEL F. TWOMEY, DIRECTOR OF TRAFFIC, CHEMICAL GROUP, CELANESE CORP.; AND WILLIAM B. MARX, EXECUTIVE DIRECTOR, AMERICAN BOILER MANUFACTURERS ASSOCIATION; ACCOMPANIED BY ROBERT WELDEN, FOSTER WHEELER ENERGY CORP.

Mr. PRICE. James Price.

Mr. FORMAN. Loren Forman.

Mr. TWOMEY. Dan Twomey.

Mr. MARX. I am Bill Marx. I would like to introduce Mr. Welden and Mr. Meyer with me, sir.

Mr. DINGELL. Gentlemen, you are all welcome.

Now that you have identified yourselves each, if you would begin. I think in the interest of time we will insert each of your statements in the record in full and recognize you for such summary.

Counsel advises me another gentleman desired to be heard, Mr. R. Timothy Columbus. Is he present in the room? He is not.

Then, gentlemen, without objection, his statement will be placed in the record.

Mr. DINGELL. Gentlemen, we will hear you, commencing first with Mr. Price.

STATEMENT OF JAMES U. PRICE

Mr. PRICE. Thank you, Mr. Chairman.

My name is James U. Price, of M. Lowenstein and Sons, a major textile manufacturing and finishing company and chairman of the Finishers Energy Conservation Subcommittee of the American Textile Manufacturers Institute. I am accompanied by James A. Morrissey, who is secretary of the ATMI Energy Policy Committee.

My appearance here today is on behalf of the American Textile Manufacturers Institute, which is the central trade association for the U.S. spinning, weaving, knitting and finishing industry. The membership of ATMI accounts for about 85 percent of the U.S. textile production. Our industry employs nearly 1 million people in 47 States.

We certainly appreciate this opportunity to offer the comments of the textile industry on Title I—Conversion to Coal and Other Fuels of H.R. 6831, the National Energy Act.

Since 1973, the American Textile Manufacturers Institute has conducted an active energy program, the basic thrust of which has focused on conservation. ATMI members are participating in the voluntary energy reporting program under the Energy Policy and Conservation Act. Our first report to the Commerce Department under this program comparing 1976 energy consumption with 1972, shows an 11.4 percent reduction in the amount of energy needed to produce a pound of fabric.

Textile manufacturers believe very strongly that reliance on the free market mechanism and voluntary conservation measures must be the foundation of a fair, equitable and effective national energy policy. Our industry strongly supports deregulation of oil and natural gas so that the free market might then encourage development of domestic resources and at the same time permit market prices to allocate fuel and encourage conservation and conversions. Government intrusions into the free market are chiefly responsible for the situation in which we find ourselves today.

Realistic pricing of natural gas and oil, at the true replacement cost, would bring about the fuel conversions voluntarily that would be mandated by the legislation you have before you today.

In the face of energy price increases and the natural gas shortages that already have been experienced, the textile industry is converting from oil and natural gas when it is technologically and economically feasible. On May 12, the Daily News Record, a publication which covers the textile industry, carried a round-up on the extent to which some companies already are converting to coal. With your permission, I would like to submit a copy of the article for the record.

This summary and additional conversions we know of illustrate that the textile industry is moving toward greater use of coal.

While we support greater utilization of coal, we are concerned that this bill does not adequately address three basic problems in connection with a major conversion to coal from oil and natural gas. These are (1) environmental impediments to greater use of coal, (2) problems associated with the transportation and handling of coal and the disposal of coal waste in and around plants that have been built to use oil and natural gas, (3) the tremendous economic impact of a major conversion to coal.

In addition to these general problems, the bill is based on the erroneous assumption that conversion to coal from gas and oil is simple. This is not the case in the textile industry. Most of our boilers were originally designed for gas and oil and are not physically suited for conversion to coal.

The textile industry has additional problems in the conversion of boilers to coal, even when the boilers were originally designed to

burn coal. Some of them were built and installed in the early 1900's. Manufacturers of the original equipment no longer make parts needed in order to make conversions. Areas that were once used to store and handle coal and ash have now been utilized for additional production buildings and facilities. The utilization of this space for these buildings eliminates the possibility of having adequate on-site storage for coal.

The conversion to coal from gas and oil will require additional energy consumption per pound of steam produced and per pound of finished textile product. This additional energy consumption will be in the form of additional coal, cinder and ash handling equipment, air pollution control devices as well as the reduced efficiency of utilizing coal in converted boilers. The estimates on the additional fuel requirements range from 4-1/2 to 10 percent.

Capital formation is another major problem. Most manufacturers want to convert to coal where it is economically, environmentally and technologically feasible. However, mandated conversion without proper regard for individual company capital needs and without tax incentives would result in tremendous financial burdens.

The bill calls for a ban against the construction of new gas or oil burning installations with a design capability of consuming fuel at a rate of 100 million Btu per hour or greater or a combination of boilers with a capability of consuming 250 million Btu. In addition, the Administrator would have authority to order conversion of certain existing boilers with the same capacity.

We question whether the Administrator should have authority to lower the threshold for boilers as provided in section 102(7)(c).

The textile industry uses a number of package boilers with a capacity of 100 million Btu or smaller. There is no technological or economic way to convert these boilers to use coal. If their conversion were to be mandated they would have to be scrapped. This would be wasteful and the amount of natural gas or oil saved would not be worth the cost of the economy.

In view of the significant economic costs to the Nation involved in ending boiler fuel use of natural gas and oil, we believe the inflationary aspects of fuel conversion could be reduced significantly by distinguishing between new and existing boilers. Conversion also should focus on those boilers which have the capability of being converted at reasonable costs. Large field boilers in the area of 300 million Btu per hour should be built or converted to use coal first.

The American Boiler Manufacturers Association has estimated that total replacement cost for units at the 120 million Btu per hour and above level would be \$49 billion exclusive of the cost of pollution control equipment. If this threshold were raised to 300 million Btu per hour, the replacement cost drops to \$24 billion, less than half that of the lower threshold. Yet, boilers in the 100 to 300 million Btu per hour range use only about 8.6 percent of the total industrial and utility boiler fuel gas and oil consumed. Obviously, the return, in terms of gas and oil conservation, is infinitely better by focusing on the large boilers.

The National Coal Association has testified before this and other committees of Congress to the effect that a good deal of coal is

already committed under long-term contracts to electric utilities. A massive program converting both new and existing boilers in the 100 million Btu. range in the proposed timeframe would result in very serious shortages and skyrocketing coal prices. This could lead to Federal coal allocation and price controls.

The national interest would be better served by permitting a phased conversion to coal based on economic incentives and the forces of free market pricing.

In closing, let me say that the textile industry has a deep and abiding commitment to conserve energy and to use fuel in the most efficient manner. We share with the Congress and the administration a great sense of urgency to get on with the job. It is particularly important that uncertainties be removed where coal conversion is concerned.

Many decisions are being postponed because industrial consumers do not know what is going to happen. We hope we can work closely and cooperatively with you to develop a national energy policy which will be fair and equitable to all consumers of energy and provide the resources needed for a strong and growing economy.

I would also like to submit for the record an article that appeared in the Wall Street Journal on May 26, yesterday, which points up this fact in some detail.

[The newspaper article referred to follows:]

Switch to Coal New Burden for Textile Mfrs.

BY RALPH REYNOLDS

CHARLOTTE, N.C. — The switch or, in certain cases, the return to coal-fired boilers is viewed as inevitable by the major supplier of natural gas to textile companies in the Piedmont Carolinas. And it adds another burden in the form of pollution control expenses for the textile companies.

The posture of various textile firms varies, with some well along the way in establishing long-range conversions from other fuels to coal; others are still in the early planning stages. But regardless of their programs' status, all agree the expenses involved are high, whether for pollution control of stack emissions or investments in new coal-fired boilers.

Most textile executives agree one of the effects of the shift in national energy policy should stimulate some growth in various sectors of the industrial fabrics market from filters to baghouses to higher demand for heavy belting fabrics as a result of stepped up coal-mining operations. But they are reluctant to even estimate in terms of general figures at this time.

They feel projections are somewhat premature, dependent on the ultimate national energy policy approved by Congress.

Forrest L. Collier, vice-president of Piedmont Natural Gas Co. here, finds "no fault in the suggestion of coal for boiler fuel. It's something that had to come sooner or later. Actually it is wasteful to use a premium fuel in boilers, but no one ever paid much attention to it until now.

"So it does make sense not to use gas as a boiler fuel when others are available. We should save the premium fuel for premium uses, as in those operations, say in textile finishing, where the gas flame is essential.

"From our standpoint, the use of coal to fire boilers does not affect us, since for the past two years, we haven't sold the huge volumes of gas that we did

five to ten years ago for major industrial users to fire their boilers. There hasn't been that amount of gas available. None in the winter and very little in the summer. So we and they have been weaned away purely and simply because of the shortages. The combination of the shortage of gas available coupled with the coldest winter in 85 years proved that point," Collier said.

Following alphabetically are summaries of the status of some major textile firms on their energy conversion and conservation programs.

At (Burlington Industries), William A. Klopman, chairman, president and chief executive, characterized that firm's posture at the annual shareholders meeting earlier this year, and company spokesmen indicated it has remained essentially the same.

Klopman reported the firm had recently installed five new large coal-fired boilers and plans to continue putting in coal boilers until about 1980 when the company will be providing over 50 per cent of its steam capacity from coal.

Burlington has equipped many of its plants with multiple fuel burning systems to protect itself from shortages of natural gas, he noted. And recently the company entered into contracts with two outside gas exploration firms to explore natural gas deposits, scoring two hits.

In discussing capital expenditures for 1977, Burlington listed some \$200-\$225 million, with approximately \$7.5 million earmarked for projects designed to reduce energy costs and provide alternate sources for steam and processing, including additional coal-fired boilers.

At Collins & Aikman Corp., Leigh Woodall, manager of energy conservation, said, "We are in the process of formulating our long-range plans in view of the national energy policy as now proposed. We do have one of our larger units now on coal for boiler steam and are planning at least a couple of conversion projects, mostly from combinations of gas and No. 6 fuel oil. But as yet we haven't established the target date for conversion.

"At the present time, we are using mechanical collectors for fly ash and with the future conversions to coal, we haven't completely decided on the route to go for pollution control," Woodall noted.

At Cone Mills Corp., Greensboro, N.C., Lewis S. Morris, chairman and chief executive, commented at the annual shareholders meeting of the firm's three larger boiler operations, one had been converted to coal; the other two use fuel oil. "We are presently in the middle of a detailed study of what would be involved in switching back to coal."

Of the three large boiler installations at Cone, one exceeds 250,000 million BTU output per hour. It is not on coal, but is equipped to use coal with the exception of air pollution devices.

The cost to install pollution control devices to meet existing regulations at Cone's largest boiler site would be in the neighborhood of \$2.5 million. The estimated cost of air pollution control devices on all the company's boilers should be approximately \$4 million.

"We have made preliminary studies on each boiler at each location and determined which can be converted and which ones should be replaced. The pace at which this will be done depends a great deal on legislation and the national energy policy," Morris said.

The cost of a new coal-fired boiler with 125,000-pound capacity is about \$2 million, he pointed out.

At Graniteville Co., Graniteville, S.C., Jerry R. Johnson, vice-president operations estimated "about 75 per cent of our boilers are on No. 6 fuel oil, 25 per cent on coal.

"We can convert another 100,000-pound boiler to coal at not much expense. This was originally coal-fired, and we converted to gas, so we will be going back in the other direction.

"Two other boilers in that same plant complex are coal-fired now so our immediate plans there are to wait and see what happens," Johnson said.

"Another thing to consider is what this will do to the boiler manufacturers. I don't think they'll be able to meet the tremendous demand that could occur," Johnson observed.

At Springs Mills, based at Fort Mill, S.C., coordinator of

energy conservation and supply, William S. Hood, explains his company's position this way.

"The Grace Bleacher plant, in Lancaster, S.C., has its own coal-fired steam and electricity generating facility. Since diesel and finishing accounts for some 60 per cent of total corporate energy consumption, the Grace operation is a tremendous factor as far as energy is concerned.

"All of the electricity and steam consumed is generated from coal. So we have 25 per cent of total energy at Grace already on coal. Company-wide, about 30 per cent of our energy is purchased electricity and the remaining 70 per cent is made up of fuels of various types from natural gas, fuel oil and coal. Of that type, 70 per cent already is coal.

"Several years ago we installed electrostatic precipitators on our power plant at Grace. So we are in good shape as far as those pollution control standards go," Hood said.

At J. P. Stevens & Co., assistant director of the manufacturing services division, W.A.L. Sibley, Jr., based at Charlotte, assesses his company's status "as not now having 50 per cent of our boiler capacity on coal, but undoubtedly we would approach at least that with some near-term plan.

"With incentives to move toward coal, we are assessing the present situation with respect to gas and oil-fired boilers and putting together a priority schedule that makes the most sense to convert those back to coal, if, in fact, it is necessary, through phaseout and replacement.

"We have quite a number of coal-fired boilers throughout the company, and a number fired by oil and natural gas. We are concerned not only with the conversion from oil and gas, but we also have to face the pollution problem in respect to coal.

"At this time, we don't have baghouses or electrostatic precipitators but use multiclones, the cyclone device, to filter out particulate matter," Sibley said.

"Fabrics associated with coal production undoubtedly would receive some impetus from the national energy policy. With baghouse fabrics, it seems these are more a function of the environmental equation and whether Congress sees fit to relax pollution standards, or in fact, make them tighter as more coal is burned," Sibley said.

Mr. DINGELL. I just want you to know, Mr. Price, the subcommittee finds ourselves very much impressed with your statement, particularly some of the suggestions you have given with regard to using things like refuse, bark, and that sort of thing in connection with construction.

I would like to get your comments on those matters after we hear the other panel members because I think they will be most helpful to us all.

Mr. Forman?

STATEMENT OF LOREN V. FORMAN

Mr. Forman. My name is Loren V. Forman, vice president of Environmental Resources and Chairman of the Corporate Energy Committee at the Scott Paper Company. I appreciate this opportunity of appearing before you today on behalf of the American Paper Institute. This is the trade association of the pulp, paper and paperboard industry.

The testimony which was submitted carries all the statistics, composition and so on, on the American paper institute. I will skip over that.

The paper industry is very proud of its energy achievements and it is anxious to make further positive contributions to resolving the Nation's energy dilemmas.

Since this statement has been submitted for the record, I am going to assume that the members have either read it or will read it, and I recommend that, and therefore I will not go over it in detail. I will just try to hit two or three of the highlights and leave time for discussion, if you wish.

I would like first to call your attention to one of the major differences between the pulp and paper industry and some of the other industrial segments.

While we rank up in the top five of the industrial categories in terms of the total energy consumption, we are unique because we supply 45 percent of our own needs from nonfossil fuels, from bark and hogged wood and process wastes and that sort of thing.

I want to emphasize the contribution of these process waste fuels because they are renewable; they are not finite, as all of the fossil fuels are. Therefore, this puts them in a preferred category in terms of saving our fossil fuels.

We actually believe at least in our industry that the conversion to more of these nonfossil fuels and maximizing the use of these nonfossil fuels really deserves a higher priority than the conversion to coal because of the reasons that I just stated.

It is not an easy thing to do. These are more expensive routes to go. These are more expensive boilers, more expensive to operate. But, in conserving the total finite fossil energy supply, here is a way to stay current with the solar energy being turned into wood substance—the raw materials which we use.

Mr. BARRETT. Excuse me, you mean by that more expensive in the initial investment?*

Mr. FORMAN. And in the operation—in most cases. Hardwarewise, certainly.

At this point we would simply make the observation that if we must convert to coal, according to arbitrary sequences and procedures, that we can see a lot of problems, which we have detailed in our written testimony. These vary from availability and cost of coal to the equipment, and other things. But, I would like to highlight particularly the last one in the list in the testimony, which is the question of the environmental conflict with the coal conversion that we see down the road.

We believe that we are going to be encountering the nondegradation problem, the nonattainment problem, and that the present procedure, as I understand it, for the NOI and NOE conversion sequence doesn't really get into the meat of the environmental conflict until you are well down the road.

If there is any one suggestion that I would make, apart from the written testimony here, it is that I believe it would serve all parties better if we could move that—the environmental decision—up earlier in the process so that we don't waste time on something which is going to be tossed out on account of the cost of environmental compatibility.

We then have mentioned in our testimony the experience of one company in our group who received NOI's recently. Fifteen of the 24 NOI's came to the pulp and paper business, and some of us got more than one. Scott Paper Company got two, and there are two boilers at each location. I could discuss those with you if you wish, but for the moment I will just say I pretty well document and agree with the testimony written here about another company, I would expand it just a little bit to point out that the method of choosing which boilers should be candidates for coal conversion by the FEA is something we don't understand yet. We are not yet on the same beam, and not moving in the same direction.

I might take just a minute to explain our procedure. Our Corporate Energy Committee has been working on this for some time and it is going to be 6 months to 1 year before we get it thoroughly sorted out. We are paying attention to two or three things in the first rank of priority.

One is to look at the overage boilers in the company. There are quite a few. Most companies of any size have boilers of all ages, and they have some that are pretty old. Boilers are like people. They don't all live the same length of time. It seems to me that we all pretty well agree that when we replace old boilers, they will be replaced with, in our case, either nonfossil fuel boilers or coal boilers, wherever that is feasible.

There is certain merit in doing that in a first-rank priority before converting the younger boilers that seem to be the focus of the present NOI program in FEA. One reason is that these are very expensive things to install. The capital limitations require some degree of scheduling. If you sequence the replacement of your old boilers in an orderly fashion, it would seem as though it will work out better than if we ignore those old boilers, focus on the younger ones, and convert them, and suddenly also have to replace the old ones with both replacements pyramided in a given year when the capital is very short.

A second reason is this: We in our business do a lot of electric generation as a part of the in-house energy consumption. We burn

the fuel, we make the steam, we make some electricity from the steam, and we also use the steam in the process. By doing that, we get about twice the efficiency out of the use of the fuel that some utilities get when they use condensing turbines and simply make steam, spin the turbine and condense the exhaust steam which heats the water—the condenser water.

Therefore, for the Nation as a whole there seems to be a compelling reason to move in the direction of cogeneration of steam and electricity, both in utilities and also in industry. We would like to do this. This takes, however, putting in boilers of a little higher pressure.

So, back to where I started. As you replace the older boilers, you would put them in for higher pressure. This would give you the opportunity in many cases to do some electric generation. That would be very positive.

Similarly on the other side, although this is out of my field, I would suggest that the siting of utilities near people who could use some steam, by-product steam, would certainly be helpful in the overall picture.

In our case, without going into details, I just want to mention a brief point about each of the two NOI's. They are too fresh to have been thoroughly digested or understood. But, we do know this—that the boilers chosen would not be in the first or second rank of our priority choosing. There are others that seem to make more sense, which would use more coal per million dollars cost of conversion, and that sort of thing.

In the case of one of our mills, the two boilers identified are burning wood. We have been led to believe that wood boilers would not be involved in coal conversion, at least not early on. We certainly would think that it might be better to hold off a little on those, and to convert boilers which are 100 percent on gas or oil, and will go 100 percent to coal, so that you will have the maximum return on the cost of this conversion.

Of the four boilers involved only one has ever burned coal, and that was some 25 years ago. All the coal handling equipment is gone. I think the criteria, as it is being applied by FEA on coal burning capability, has been made a little bit too all-inclusive—to just look at the design of the boiler box itself, if that is what they are doing, and that is what it seems like.

In the case of the other NOI the mill is near an urban location. For example, in this location there are some old boilers that to me would make more sense to be converted, that is, replaced, first, sometime in the next 10 years. We are on our own moving out of gas first and then replacing oil with the nonfossil fuels where possible, and then going to the coal where this is feasible.

There are a few boilers which did burn coal within the last 10, 12 years, and probably could be converted at a minimum cost, and this will be considered as we prioritize these things.

This urban location, if we would convert now, would cut us off from the possibility of the alternative routes which are indeed very attractive and wise routes. One of these is the use of municipal waste. We are seriously considering providing the energy requirements for this mill from the combustion of the combustible portion

of municipal wastes. If these two boilers are converted to coal now, as the NOI sequence has started rolling, that option will be excluded. We cannot do that.

Secondly, for a long time we have been interested in this possibility of cogeneration, with a very large utility nearby. In our investigation of that, 3, 4, 5 years ago, we found no interest on the part of the utility because it felt that its regulatory requirements prevented it from doing much in that direction.

Mr. DINGELL. You say you found no evidence of interest from them because of the regulatory requirements? What regulatory requirements are you referring to?

Mr. FORMAN. This was a foreign thing to their way of thinking.

Mr. DINGELL. No regulatory bar from state or Federal Government?

Mr. FORMAN. I cannot give you the details. My impression was they felt their regulatory restrictions focused them on the delivery of electricity, not steam.

Mr. DINGELL. Not steam?

Mr. FORMAN. That was my impression, and we would like to buy both.

Mr. DINGELL. In what State was this?

Mr. FORMAN. This is Pennsylvania.

Mr. DINGELL. Is there any requirement in Pennsylvania law on this point that bans them from doing this?

Mr. FORMAN. I can't answer that. But, I can tell you the point of my story is they are now interested. This is good news for us. We are going to investigate it. I don't know if it will work, but it is an alternative here which would be a very desirable one, which would be ruled out if we go ahead and convert at this point. That is my message.

So, to wind it up, we are trying, as you are, to sort this thing out and get the most effective, most economical, and most efficient way to proceed with it. Our industry indeed stands ready to work with you and FEA, if we may, to help you and to help us find the right solutions.

Thank you very much.

[Mr. Forman's prepared statement follows:]

STATEMENT OF AMERICAN PAPER INSTITUTE, INC.

INTRODUCTION

I am Loren V. Forman, Vice President, Scott Paper Company. I appreciate this opportunity of appearing before you today on behalf of the American Paper Institute, the trade association of the pulp, paper and paperboard industry.

The 200 member firms of the Institute produce more than 90% of the pulp, paper and paperboard manufactured in the United States. Net sales of the paper and allied products industry in 1976 were \$39 billion. The industry employs about 680,000 people in approximately 6,000 facilities. Last year, its outlay in wages, salaries and benefits amounted to over \$11 billion, and it paid approximately \$2 billion in federal, state and local taxes.

The industry welcomes the efforts being made by the Administration and the Congress to develop an effective national energy program with emphasis on energy conservation and reduced dependence on imported petroleum fuels.

With due respect to these considerable efforts, however, we believe that inadequate attention has been given to stimulating domestic supplies of appropriate fuels, and to the multiplicity of problems for industry in a program which would add to the regulatory role of government.

However, the paper industry is anxious to make a positive contribution to resolving the nation's energy dilemmas and I feel that I can be most helpful by giving you briefly some background on what our industry has achieved to date in its conservation of energy and in its efforts to shift away from petroleum-based fuels. I then plan to point out how the proposed amendments to the Energy Supply and Environmental Coordination Act of 1974 would affect the paper industry and suggest certain changes.

THE PAPER INDUSTRY'S PATTERNS OF FUEL USE

While the paper and allied products industry ranks among the top five manufacturing industries in total energy consumption, it is unique because it generates 45% of its energy requirements from non-fossil, self-generated, waste fuels. These fuels include bark, hogged wood (chipped residues from forest and manufacturing operations) and

spent pulping liquors from which chemicals as well as energy are recovered.

I want to emphasize the contribution of these process waste fuels because they are renewable, being derived from trees which themselves utilized solar energy.

The self-generated proportion of the industry's total energy requirements has been increasing - from 42% in 1972 to 45% last year. Over recent years, the industry has been substituting wood-waste fuels for oil and natural gas. This substitution has been made in response to market forces. We believe, also, that this is in line with the intent of the Administration's proposed program. In 1976, the substitution represented an equivalent annual saving of 8.4 million barrels of oil.

This trend has been revealed by API's monthly Energy Monitoring System in which 85% of the industry's capacity regularly participates. The system has also revealed other trends in fossil fuel and purchased energy use between 1972 and 1976. For example, the industry's use of natural gas has declined from 20% to 15%, fuel oils have increased from 23% to 24% and purchased electricity from 4% to 5%. We estimate electricity needs, approximately 75% of which was cogenerated, that is, generating electricity as a by-product of process steam production.

Since coal is the subject on which your Subcommittee is concentrating today, let me report that the paper industry's use of coal declined from 10.5% in 1972 to 9.1% in 1975, partly as the result of environmental requirements but also because, for many mills, it was simpler and cheaper to use natural gas or fuel oils. Natural gas was particularly attractive because government regulations had kept its price artificially low in interstate markets, and it is unquestionably the cleanest of all the fuels. By 1976, however, API's data show that the contribution of coal had begun to move up to 9.5%. A number of companies apparently concluded that, in the longer term, coal would be a more reliable source of energy than natural gas and oil.

As another indication of the industry's shift away from imported fossil fuels toward using more of its own wastes, we would call your attention to the following table, based on information compiled by the American Boiler Manufacturers' Association (ABMA).

BOILERS ORDERED BY PAPER AND ALLIED
PRODUCTS INDUSTRY, 1974 - 1976 - BY FUEL TYPE

<u>FUEL TYPE</u>	<u>NUMBER OF UNITS</u>	<u>CAPACITY</u>	
		<u>(lbs. Steam/hr)</u>	<u>% of Total</u>
Spent Pulping Liquor	20	7,200,000	43%
Bark & Hogged Wood	15	4,085,000	24%
Fuel Oils	27	3,947,000	23%
Coal	4	983,000	6%
Natural Gas	13	729,000	4%
TOTAL	<u>79</u>	<u>16,944,000</u>	<u>100%</u>

These figures are further evidence that with a total of only 27 percent of new boilers being based on fuel oils and natural gas, there has already been a considerable movement in the direction of the industry's own wastes and to some extent toward coal as energy sources.

PROBLEMS WITH COAL

Expanded use of coal by the paper industry involves a number of broad aspects which raise grave questions that this Subcommittee and the government should consider.

- a) Does the national interest warrant the mandatory use of coal by those pulp and paper plants in states which are remote from existing coal mines?
- b) Will the nation have the capability to produce the enormous amount of equipment needed to mine, transport, handle, burn and clean up the air emissions from coal?
- c) Is it realistic for the Administration to expect the nation to almost double its production of coal between 1976 and 1985 - from 7.9 to 14.5 millions of barrels of oil equivalent per day?
- d) Will the environmental consequences of expanded use of coal add substantially to the industry's already heavy burden of capital investments required to meet present and future air and water standards?
- e) Will many of the plants thought to be capable of conversion to coal be permitted to effect the change because they are located in non-degradation and non-attainment areas?

FEA'S CONVERSION ORDERS AND THE PAPER INDUSTRY

Under existing legislation, the Federal Energy Administration recently issued Notices of Intent, the first step in implementing its authority to prohibit oil and natural gas use in certain existing industrial boilers and to require that new boilers be built with alternative fuel-burning capability. Of the 24 existing facilities, 15* are owned by pulp and paper companies, representing 11% of the industry's 1977 total paper and paperboard capacity.

It is ironic and totally contrary to the efforts designed to reduce dependence on imported fuels that at least two of these fifteen facilities are multifuel or combination boilers using bark for the major proportion of their fuel.

The ten pulp and paper companies that have been served with the 15 NOI's to convert to coal have individually estimated their costs of converting and meeting expected environmental standards. The combined total exceeds \$400 million. These additional and usually non-productive expenditures will seriously inhibit the ability of a significant proportion of the industry to add new capacity to meet the nation's future needs of pulp, paper and paperboard.

One API member company has been served with coal conversion NOI's for four of its 18 existing primary pulp, paper and paperboard mills. In public hearings earlier this week, this company pointed out that, on the basis of a cost-effective analysis, it has concluded that FEA has not selected the mills most appropriate for coal conversion. These conclusions were based on such factors as locations unfavorable to coal, approaching obsolescence and the availability of waste fuels. This company also expressed its determination to develop a strategy to systematically reduce its oil and natural gas requirements and to identify appropriate conversion opportunities. Obviously, more careful and expert analysis on the part of the FEA is called for in its current efforts to achieve expanded industrial use of coal.

*These 15 facilities are located in:

Alabama (1)	Michigan (1)	South Carolina (1)
Arkansas (1)	Mississippi (1)	Tennessee (1)
Georgia (2)	North Carolina (1)	Texas (1)
Maine (2)	Pennsylvania (1)	Virginia (2)

THE POTENTIAL OF WOOD WASTES SHOULD BE RECOGNIZED

In its efforts to achieve a switch away from oil and natural gas by the pulp and paper industry, the Administration should not regard coal as the only major alternative fuel. Energy legislation should clearly and specifically recognize the potential of wood and the manufacturing wastes of the forest-based industries as logical, economic and environmentally acceptable alternatives.

We would suggest the following:

1. Any legislation which the Congress enacts as a means to encourage a larger degree of energy independence should contain provisions which allow for the specific use of non-fossil, renewable fuels such as bark, hogged wood and spent pulping liquors. Municipal solid wastes could also qualify as an appropriate alternate fuel to oil and natural gas in many boiler applications. Our industry favors the maximum economic recovery and recycling of the paper component of solid waste before the combustible component is burned.
2. Current legislation and proposed amendments, in our view, give the Federal Energy Administrator unnecessarily broad authority to prohibit industrial use of oil and natural gas as well as to require conversion to alternative fuels. Experience with recent NOI's clearly indicates that the FEA does not have the best available information as a basis for valid decisions in this area, especially in regard to the paper industry's combination boilers capable of burning non-fossil, process wastes. We would recommend that such combination boilers be exempted from prohibition orders if their average annual use of non-fossil, waste fuels is 75% or more on a BTU basis.
3. Expanded use of waste fuels and coal in the pulp and paper industry could be accelerated by appropriate incentives, particularly in the tax area. The API testified to this effect before the House Committee on Ways and Means on May 18, supporting the proposed 10% additional investment tax credit for energy-related facilities which would use more of the industry's own wastes.

THE PAPER INDUSTRY WANTS TO MAKE FURTHER CONTRIBUTIONS

Let me repeat my earlier statement - the pulp, paper and paperboard industry is anxious to make further contributions to resolving the nation's energy dilemmas and reducing

our dependence on foreign sources of energy.

We feel that this can be done by the regulatory agencies working more closely with industry in order to develop sound information on which to base the nation's over-all energy programs.

Business must make its decisions largely on the basis of free market influences and the government should recognize that its regulations add a high degree of uncertainty to those decisions concerned with energy.

Finally, let me reiterate the paper industry's strong preference for the free market mechanism rather than price controls on oil and natural gas. Much of our present problem is the direct result of past controls on natural gas. We believe that a free market approach to all the fuels available to industry will assure impressive results by bringing to bear on the problems the innovative and creative abilities that have brought this country to its enviable level of economic and social development.

Mr. DINGELL. You have given us a very helpful statement which we wish to pursue further.

Mr. Twomey?

Mr. PRICE. Excuse me, Mr. Chairman. May I be excused. I have a plane to catch. Mr. Morrissey, with the ATMI, will be here to take any questions.

Mr. DINGELL. I apologize for our having held you.

Mr. PRICE. I am sorry I can't stay.

Mr. DINGELL. You go with the thanks of the committee. Thank you.

Mr. PRICE. Thank you.

Mr. DINGELL. Mr. Morrissey, would you identify yourself.

Mr. MORRISSEY. I am James Morrissey, secretary of the Energy Policy Committee of the American Textile Manufacturers Institute.

Mr. DINGELL. All right. We recognize Mr. Twomey.

STATEMENT OF DANIEL F. TWOMEY

Mr. TWOMEY. Mr. Chairman, members of the committee, my name is Daniel F. Twomey, Director of Traffic, Chemical Group, Celanese Corporation, a diversified producer of petrochemicals, fibers, plastics, coatings, and specialty chemicals.

As a result of the Texas Railroad Commission Docket 600, Celanese is converting its Pampa, Texas, plant from gas-fired boilers to coal-fired boilers in 1979 at a cost in excess of \$70 million. The conversion will not increase our production capacity. Of this \$70 million, \$20 million will be for coal handling facilities, and \$4 million will be for the purchase of coal hopper cars. We will be obtaining our coal from Wyoming or Colorado, where the railroads have a virtual monopoly in transportation.

Mr. DINGELL. You are talking about your company receiving its supply of coal from Colorado or Wyoming, regardless of where the plant is located?

Mr. TWOMEY. The plant is located in Pampa, Texas. We conducted a 2-year study for source of coal and zeroed in on these two areas.

Mr. DINGELL. You are talking just for one of your plants.

Mr. TWOMEY. Right, Mr. Chairman.

Our concerns in the transportation area relate to, one, obtaining a sufficient number of coal hopper cars to move 600,000 to 800,000 tons of coal annually, from 700 to 990 miles.

Secondly, maintaining these cars in first-class operating condition.

Thirdly, obtaining an equitable unit train freight rate for the movement of coal.

The number of coal hopper cars we will require will depend on the source of the coal. Inasmuch as we have been unable to obtain a realistic freight rate from the railroads, we are still at this late date unable to place an order for the cars.

With respect to the acquisition of these coal cars, the Carter energy legislation contains a provision for a tax credit for equipment used for unloading and transferring coal. We believe this provision should be broadened to include an investment tax credit for the substantial capital which will be dedicated to coal car acquisition.

Our second area of involvement, insuring that the rail cars will be maintained in first-class operating condition, has been very difficult and very time consuming for us. We have two choices. We can install our own maintenance facility at Pampa, or we can try to have the work done by an outside contractor. As of this date, we have been unable to find anyone willing to do this for us.

Our problem lies in the nature of the unit train movement. It is unlike anything Celanese has experienced in the past. For example, we have been operating a large tank car fleet for many years. Ask us anything about tank car maintenance costs, and we can almost answer you to the dollar. We have a detailed historical record filed to draw from on tank cars, which travel an average 24,000 miles a year.

But, these coal cars will travel 130,000 to 140,000 a year, or six to seven times as far as a tank car, and no one has any meaningful long-term historical maintenance data on them.

Under the circumstances, we think we have done the best we possibly can do. We have visited with railroads, shippers, receivers, car builders, and car component builders to discuss their maintenance experiences, limited though they may be.

On this basis we are projecting a maintenance cost of 4 cents per running mile on these cars or approximately \$5,500 per year per car. A new tank car could be maintained for less than 1/10th of this cost.

Our third area of involvement and the most frustrating involves our efforts to obtain an equitable freight rate. We believe our rate should approximate the level of rates now in effect to such points as Amarillo, Texas, which is only 48 miles from Pampa, San Antonio, and Welsh, Texas, Pueblo, Colorado, and other points. After all, the

transportation characteristics of our movement are basically the same as those I just mentioned. But the railroads tell us that they don't make unit train rates like this any more. They tell us they have a new rate level for us, and this is what they are trying to put over on us.

Well, this is exactly what they told the San Antonio Public Service Board. San Antonio took them to the Interstate Commerce Commission and the ICC recently prescribed a rate in line with what San Antonio had felt they were entitled to. The railroads appealed this action in Federal court, but the court upheld the ICC.

Since this time, Arizona Electric Power Cooperative and Houston Light and Power have filed similar complaints which are now pending before the ICC.

Furthermore, I understand Central Power and Light at Corpus Christi, Texas, is about to file a similar complaint. If we at Celanese cannot resolve our differences with the railroads very shortly, we will be doing the same thing.

We are being asked to pay artificially high freight rates by the railroads because they know they have no competition for the movement of western coal. In our opinion, this is a short-sighted attitude on their part, and it will hasten the day of the coal slurry pipeline which Celanese favors. When this happens, their so-called captive traffic will begin to disappear.

This concludes my statement, Mr. Chairman. Thank you very much for the opportunity to appear before you.

[Mr. Twomey's prepared statement follows:]

STATEMENT
BY
CELANESE CORPORATION
PREPARED BY
DANIEL F. TWOMEY
BEFORE THE
SUBCOMMITTEE ENERGY AND POWER
OF THE
INTERSTATE AND FOREIGN COMMERCE COMMITTEE
CONCERNING
THE TRANSPORTATION ASPECTS OF THE COAL CONVERSION OBJECTIVES
OF THE
PRESIDENT'S NATIONAL ENERGY PROGRAM

May 27, 1977

Mr. Chairman, members of the Committee, my name is Daniel F. Twomey. I am Director of Traffic, Chemical Group, Celanese Corporation, an independent petrochemical company. In my present capacity I am responsible for ensuring that the raw materials which we receive and the chemicals which we produce at Pampa, Bishop, Bay City and Clear Lake, Texas, Rock Hill, S.C. and Newark, N.J., move via the most economical means consistent with our service requirements and those of our customers.

I appear before you today in connection with "Title I - Conversion to Coal and Other Fuels" of H.R. 6831, the National Energy Act.

As a result of Texas Railroad Commission Docket #600, gas contracts for boiler fuel cannot be made, extended or altered after December 17, 1975 without having an exemption granted by the Texas Railroad Commission. Therefore in order to ensure the continued operation of our Pampa, Texas plant conversion to coal is necessary before the expiration of our current gas contract.

Our Pampa, Texas plant which manufactures a variety of chemicals such as Acetic Acid and Anhydride, Methyl Ethyl Ketone, Methyl Acrylate, 2 Ethyl Hexyl Acrylate, Propionic Acid and Formic Acid currently generates its required steam in gas fired boilers. Gas is currently supplied under a contract calling for decreasing volumes up to its expiration in 1980. It is our intention to replace these gas fired boilers at Pampa with coal fired boilers in 1979.

When this complex project is completed we will have spent in excess of \$70 million dollars to convert from gas to coal and we will not have increased our production capacity. Of this total amount approximately \$20 million dollars will be for coal handling facilities and approximately \$4 million dollars will be for coal hopper cars to transport the coal.

Celanese is a major user of railroad services throughout the country. As a matter of fact 64% of our transportation bill is paid to the nation's railroads who transport 51% of our tonnage. Our interest in a financially sound railroad network is second to none, and the economic well-being of each of our plants is highly dependent upon safe, efficient, economical railroad service.

As receivers of coal from the west, Celanese will be responsible for selecting the transportation mode to be used (in this case we have no viable alternative to rail service in the next few years).

The Carter Energy legislation contains a provision for a tax credit for equipment used for unloading and transferring coal. We believe that this provision, should be broadened to include an

investment tax credit for substantial capital which will be dedicated to coal car acquisition. We also believe that the credit should be made effective from the date of the President's proposal.

We will be responsible for supplying the coal hopper cars necessary to transport the coal and paying the applicable freight charges - if we can ever negotiate an equitable unit train freight rate with the railroads.

Let me briefly describe to you the transportation aspects of Celanese Pampa coal conversion project, our areas of responsibility concerning the project and where we are after nine months of effort.

Our primary areas of concern are:

- 1) Securing the necessary rail cars to transport from 600 thousand to 800 thousand tons of coal annually over a distance of, from 700 to 990 miles.
- 2) Developing a preventive maintenance program for the cars in order to ensure safe operation of the unit train.
- 3) Obtaining an equitable unit train freight rate to cover the transportation of the coal.

As a result of past practices with respect to unit train movements of western coal, the railroads require the shipper and/or the receiver to furnish the necessary coal hopper cars. We are now in the process of obtaining a sufficient number of suitable hopper cars to handle coal from one of two places: the Powder River Basin

area of Wyoming or the area around Hayden, Colorado. Firm quotations have been received from only five of the twelve car construction companies to whom we submitted bids.

Although we requested a purchase and full service lease price from them, four firms quoted a purchase price only and one firm offered to submit a full service lease proposal.

The number of cars required for our movement will depend on the source of the coal. Inasmuch as we have been unable to obtain a realistic freight rate from either source under consideration, we are still, at this late date, unable to place an order for the required coal cars.

Our second area of involvement, recommending a preventive maintenance program for the cars will require a decision on our part to:

- 1) Install a maintenance facility at Pampa to perform running repairs on the cars in order to protect the integrity of the unit train
or
- 2) Evaluate the feasibility of having the maintenance done for us by an outside contractor.

At the present time, no contract repair facility exists between the Colorado origin and Pampa, Texas nor are we aware of any plans to construct such a facility.

Developing a preventive maintenance program responsive to our needs has been and will continue to be very difficult and very time consuming. The movement of these coal cars will be unlike any-

thing Celanese has experienced in the past. While the average tank car in our fleet travels approximately 24,000 miles in any given year, these coal cars will travel approximately 130,000 miles per year or 140,000 miles per year depending on the source of the coal. In other words, these cars will be getting six to seven years wear and tear on them in one year when compared to a tank car.

As a result of this and the fact that no one around has any meaningful historical maintenance data covering unit train operations for movements this long, we are contacting any and all railroads, shippers and receivers of unit trains of western coal in order to assist us in projecting maintenance costs and sizing our fleet of coal cars. Based on the information we have obtained thus far, we are using a figure of 4¢ per running mile as a maintenance cost on these cars. A new tank car could be maintained for less than one tenth of this cost.

Last but not least insofar as our areas of involvement is concerned has to do with our efforts to obtain an equitable unit train freight rate to cover the transportation of our coal requirements.

Quite frankly, the negotiations which commenced in September of 1976 have been rather frustrating. Basically, our position has been that the rates we should have from Colorado and Wyoming should approximate the level of unit train rates now published to other consuming points such as Amarillo, San Antonio, and Welsh, Texas; Pueblo, Colorado and Kaiser, California, giving due consideration to the different distances involved. On this basis, we believe a rate in the area of \$8.00 per ton should apply from Wyoming and something in

the area of \$6.00 per ton should apply from Colorado.

The final offer we received from the railroads is substantially higher than these figures. As a matter of fact we consider it completely unrealistic. We will have one more meeting with the railroads and if we are unable to make significant progress towards obtaining an equitable unit train rate, we will be forced to file a formal complaint with the Interstate Commerce Commission as was done by the San Antonio Central Public Service Board, the Arizona Electric Power Cooperative and the Houston Light and Power Company.

The development of vast new coal deposits in the west - much of which will be marketed in the Texas area - represents a tremendous new business opportunity for the railroads to significantly increase their earnings without having to rebuild their existing plant - much of which is today under-utilized. On the other hand the almost total reliance of shippers and receivers on transportation by rail makes it absolutely essential that the pricing of railroad transportation services be free of monopolistic pricing tendencies.

Please do not misunderstand me. This is not to say that we espouse freight rates which are set so low as to deprive the railroads of a fair rate of return on their investment. Nothing could be further from the truth. As I previously mentioned the economic well-being of our plants and those of all shippers for that matter, depends on a financially sound railroad system.

What we do vigorously object to - and what we are experiencing today - are attempts by the railroads to set unit train freight rates at an artificially high level - in the absence of any meaningful inter-modal competition.

Mark my words. If the current monopolistic - you have no alternative - pricing policies of the railroads persist and prevail, the day of the coal slurry pipelines will be upon them much sooner than they expect. In fact their "captive" shippers and receivers will become the driving force behind their construction. And sad to say, the glowing promise of heretofore undreamed of increases in their earnings for decades to come, will be irretrievably lost to the railroads.

Mr. DINGELL. Thank you very much, sir.
Mr. Marx.

STATEMENT OF WILLIAM B. MARX

Mr. MARX. Thank you.

I am William B. Marx, executive director of the American Boiler Manufacturers Association.

I think that I will, if it is all right with you gentlemen, run through our statement rather informally, highlighting the portions that seem to me to be of interest in light of this testimony, what I heard this morning.

Mr. DINGELL. Very well.

Without objection, your full statement will be inserted in the record, and we will recognize you then for the summary.

Mr. MARX. Thank you, Mr. Chairman.

On page 1 we make some basic points about conservation, conservation to us meaning taking an existing boiler which is burning one fuel and equipping it or redesigning it, rebuilding it, retrofitting it, to build another.

You will see we make the point that gas and oil-fired units are relatively convertible back and forth, but that neither one is convertible to coal unless in fact that unit had been designed originally with coal in mind.

If you will excuse this informality, I have some pictures here which I wish I had on a full scale. The first two are utility boilers. We have two basic designs, those for utilities and those for industrials. The first one is of a coal-fired unit and then page 2 is of a gas-fired unit. Those two happen to be fairly much on the same scale. Those are exactly the same capacity.

I think you can visualize the inability of taking the second one and making it into the first one. In other words, we would have to burn much more fuel in that smaller unit, and it just simply cannot be done.

If you go to the next two, pages 3 and 4, and they are not to comparable scale—if they were it would be even more dramatic—the first unit is a coal-fired boiler, and the second unit an oil-gas-fired boiler for industry, and I think you can see the impossibility of

making that unit on the fourth page into what you see on the third page. This point has been made by them and I guess it is beginning to be accepted, but I thought maybe looking at those, and I will be glad to leave those books with you.

I think the last two are as pertinent as any, and those show the relative total area required for a steam plant. The next to the last sheet in the book shows you the area which is required for a typical oil or gas-fired boiler plant. It is about 14 acres. The last page shows you the same size boiler plant coal-fired. Now, this is a worst case situation. We are exaggerating, but it could be this great. That is 300 acres.

In other words, you need 20 times the space in some situations. In any situation it would be at least five times. That, as I say, is perhaps every bit as important or more so than the boiler difficulty.

If I may, to go on to item B. On page 2, I will briefly touch on capital costs. We have first cited the example of a relatively large industrial boiler, a 250,000 pound an hour unit. This is a unit of roughly 25 megawatts if you put it in electrical terms. You can see the difference in cost between the coal-fired unit and an oil or gas-fired unit, \$10 million as opposed to about \$3.5 million, and this comparison does not include the flue gas desulfurization system. If you include that you are looking at \$5 million, or something awfully close to a five-to-one ratio. This is a typical large industrial situation such as I think perhaps Mr. Forman might find himself involved with, this kind of capacity in a large energy-intensive industry such as paper, chemical, and refining.

On the next page we give some relatively different costs for utility units. Here we are, of course, assuming coal. Our order books show that in 1974 there were like one or two small noncoal-fired utility boilers ordered. There was one ordered in 1975, and there was none ordered in 1976. So these are just coal. We have cited the cost of a 600 megawatt unit, and if this were placed on order today, and these are 1977 dollars, you would have commercial operation about 1985. These figures, incidentally, do include scrubbers, \$425 million for 600 megawatts, \$500 million for an 800 megawatt, and \$700 million for a 1,200 megawatt, and I have made the point that as you double in size you save about 20 percent in unit cost, that is, unit size cost. These are enormous figures and you can see, and that is on a unit basis, if you build a plant within let's say two-1200 megawatts units you would have a plant at a site with an excess of a billion dollars invested.

Item C, marketplace data. Here I have made the point that not only have utilities stopped buying oil-fired units but our industrial customers here at this table insofar as large units are concerned have ceased to buy them too. You will note down at the very bottom of the page in 1973 we sold 45 large industrial oil or gas-fired boilers. In 1974 we sold 54; in 1975, 21, from 1973 to 1975 down to 21. Last year none. Whereas the ordering rate of industrial coal-fired boilers has been essentially flat in recent years, and that is true. It runs at about 7 percent, and it is running that way this year.

To back up what Mr. Forman emphasized, a significant increase in the total of non-oil or gas-fired boilers, that is, those firing coal

and by-product and waste fuel as well as coal, has occurred. From a 1972 figure of 22.7 percent of industrial boiler sales, these units are now up over one-third. And I made the point that our oil inquiries for industrial boilers show that the inquiries for coal and refuse-fired units run about two-thirds of the total. And in corroborating this trend a leading boiler consulting firm in the industrial field reported to me about a month ago that he had no gas-fired boiler inquiries on his books, and only 10 percent oil-fired boiler inquiries, with of course the obverse being 90 percent for refuse or coal.

There has been a lot of talk about the capacity of boiler service to respond to a boiler program, and that is why I include this next statement on page 3:

While an exact determination to total U.S. steam generator manufacturing capacity has never been made, industry estimates range from 20,000-30,000 megawatts coal-fired utility units and 6,000-7,000 megawatts coal-fired industrial units. We believe this capacity is adequate to respond to any credible national coal conversion schedule, and we have looked at this in some detail. In fact, one company projection I saw looking at coal-fired utilities boilers through about 1993 as I remember showed that in the peak year orders would run no more than 26,000 megawatts. So we sincerely believe that our industry's capacity is there right now.

There was some conversation this morning on new technologies in fluidized bed, and I think it is important to realize that these technologies are in the future. Perhaps the one which will come most rapidly is fluidized bed. Depending in our industry whether you are a bull or a bear, we think they will be offered on a commercial basis to industry in something like 3 to 5 years, but in the utility area we don't see them being purchased until 12 to 15 years from now.

Mr. DINGELL. Can you parenthetically tell us why so long, that 15-year period?

Mr. MARX. Well, yes, I will. ERDA has a number of projects that they are pursuing in the fluidized bed area and in the boiler field I guess they are probably in the neighborhood of seven to eight, and our member companies are involved in all of them. The largest unit and, interestingly enough, the one which is the closest to commercial operation, is in a utility plant in Rivesville, West Virginia, the Monongahela powerplant. It is 30 megawatts. This is somewhere towards the top of the line, so to speak, or the top size of an industrial unit, and although it is in a utility plant, and although at the time that project was conceived they were looking for utility impact, I think the perception of all of us is now that the result of the test of that unit will have quickest application to industry.

To go to utility size unit is going to require tremendous scaling up, and even when we were dealing with known technology as we were back, oh, perhaps in the early 1960s and so on we got into a fair amount of trouble when our utility customers were extrapolating average sizes at a great rate.

So I just think that it is going to take a number of steps in terms of size I believe to get to that point. I also think that utilities are going to be a little bit cautious about making the huge investments required, and I think they will be watching of course very carefully

the results of the industrial sector, coupled of course with the fact, Mr. Chairman, of the extremely long lead time for a conventional unit. You start out with something like 5 to 8 years from date of order to commercial operation to begin with with existing technology.

I would like to make just one or two final points. There has been a lot of discussion about where the size limit should be. We have not stated for the record our opinion on that but I would like very, very strongly to say that wherever that comes out we would hate to see FEA be given the authority to reduce that limit in a given situation, and that was my point four on page 4. Otherwise the uncertainty syndrome will be perpetuated. Our orders are down where they haven't been this low for 40 years.

Mr. DINGELL. You have emphasized this point of certainty and uncertainty. That seems to be a major part of the problem. You have indicated that uncertainty with regard, I assume to Government policy, although you didn't say that is the major part of the problem we have in terms of getting the transfer. Is that right?

Mr. MARX. Yes.

Mr. DINGELL. Would you like at this time to address yourself with a little more force please to that?

Mr. MARX. Yes. The uncertainty of course exists in the marketplace, our marketplace, among our industrial customers and utilities customers, and I think there are two major ingredients here. On the utility side I believe the fuel picture is quite clear. As I have indicated, utilities are buying strictly coal, although I am sure they have concerns about perhaps being forced to retrofit in difficult situations. But they are concerned with environmental considerations, and whether or not they are going to be forced to put flue gas desulfurization systems on the back end of a steam generator even though it is firing low sulfur coal.

I think the capital costs associated with these scrubbers, they are tremendous, but when you get down into industrial sizes this factor becomes even more prominent. The unit cost goes up something like four times when you scale down from a utility size unit to an industrial unit. So that the cost of a scrubber in an industrial plant will generally exceed the cost of the boiler itself, and an awful lot of industrial firms I believe are waiting to see whether or not they will be forced to put this piece of equipment on the back end of their units, and I think many of them if they are forced to will not build new coal-fired units.

Finally—I pointed this out before, but I would like to read the summary—conflicting and confused signals from Washington in the closely related energy and environmental areas have cast a pall of uncertainty over U.S. industry and utilities; inaction is the inevitable result. New orders for steam generators in 1976 and so far in 1977 are running less than one-third of normal, i.e. at about the level of the 1930's. This means the Nation's coal conversion program is stalled. Legislation enacted must, therefore, reflect a policy which is clear, consistent and predictable over the period it is designed to affect. To prolong this uncertainty will cause grave damage to the Nation's energy supply.

I thank you very much, gentlemen.

[Mr. Marx's prepared statement follows:]

Written Statement
on
(H.R. 6831) National Energy Act
"Title I - Conversion to Coal and Other Fuels"

Subcommittee on Energy and Power
(Committee on Interstate and Foreign Commerce)
House of Representatives

May 27, 1977

A. DESIGN

1. Gas-to-Oil Conversion

Most gas-fired boilers can be readily converted to oil at reasonable cost. Changes must be made to the fuel burning equipment and controls; modification of the internal boiler pressure parts may be required; and oil storage facilities, oil handling equipment, boiler cleaning equipment (soot blowers) and additional heat transfer surface will have to be installed in most cases. Little or no unit derating, however, is required.

In short, an oil-fired boiler is very similar to a gas-fired boiler although pollution control equipment will have to be added to the larger units.

2. Gas-to-Coal Conversion;3. Oil-to-Coal Conversion

If the unit was not initially designed for future coal-firing, gas-to-coal or oil-to-coal conversion of an industrial or utility boiler is virtually impossible and totally impracticable, both as relates to economic feasibility and boiler capacity, which can be reduced as much as 60%. All design parameters are radically different:

- a. Coal furnace usually twice as large;
- b. Much more liberal boiler tube spacing required;
- c. Boiler hoppers are needed;
- d. Added plant requirements:
 - 1. Extensive and expensive pollution control equipment;
 - 2. Ash handling equipment;
 - 3. Coal handling equipment;
 - 4. Coal pile area, etc.

THIS SITUATION REALLY MEANS BOILER REPLACEMENT.

4. Coal-to-Oil (gas)-to-Coal Conversion (Unit originally designed for coal-firing later converted to oil or gas)

In most instances a coal-fired unit later converted to oil or gas can be reconverted, depending upon how drastically the initial conversion was carried out. If the new coal differs greatly from the design coal, however, severe operating and capacity limitations could be encountered.

5. Plant and Site Factors (coal versus oil or gas)

- a. Five to twenty times the total plant space is needed; this includes coal pile area, coal and ash handling equipment, larger boiler and auxiliaries, and in many cases, a buffer zone; the site often will be located in an urban or suburban area where a plot of the needed size may not be available;
- b. Additional operating personnel are required;
- c. Higher operating costs are incurred;
- d. Fuel costs will be lower but differences will vary.

6. Upgrading and Modernizing Equipment; Increased Efficiency and Reliability

In order to increase the efficiency of an existing steam generator the following can be added:

- a. Increased heat transfer surface; (economizer or air heater)
- b. New components; (superheater, burner, tighter boiler enclosure, etc.)
- c. Soot blowers; (ash cleaning equipment)
- d. Blowdown recovery system;
- e. Modern combustion control system.

By-product and refuse fuels firing or waste heat utilization can sometimes be added to an industrial or utility boiler plant. (See Exhibit "A")

B. CAPITAL COSTS (New Units)

The natural gas shortage will continue to force the use of alternative fuels whose selection will be governed primarily by availability and equipment costs. For example a recent survey of 300 large industrial steam users showed two-thirds more concerned with reliability of fuel supply than with cost.

The capital cost barrier can be great; an industrial coal-fired boiler plant of 250,000 pounds of steam per hour capacity will cost approximately \$10 million with a lead time of up to three years from order to commercial operation. In addition, if a flue gas desulfurization system ("scrubber") for the burning of high sulfur coal is required, \$5 million must be added to plant capital costs. This amount is one-third greater than the total boiler equipment cost of \$3.75 million.* (See Exhibit "B") On the other hand, an oil-fired unit costs approximately \$3.5 million and could be placed in operation within 9-12 months from date of order. Thus, the economic impact caused by mandating gas and oil industrial boiler replacement by coal must be considered as it could affect the financial viability of an entire enterprise.

*This is underscored by the same survey which showed the principal coal-firing constraint to be environmental problems associated with boiler emissions.

Capital costs for a utility coal-fired plant are enormous. A 600 megawatt unit ordered this year for commercial operation in 1985 will cost about \$425 million, including flue gas desulfurization; an 800 megawatt unit, \$500 million; and a 1200 megawatt unit, \$700 million. (Note a unit saving of about 20% with a doubling of size.)

C. MARKETPLACE DATA

Industry statistics show that utilities have virtually ceased buying oil or gas-fired units. Exhibit "C" shows that from a 1970 peak of 60% for these two fuels, 1974-75 purchases of oil and gas-fired boilers were insignificant and none were ordered in 1976.

Whereas the ordering rate of industrial coal-fired boilers has been essentially flat in recent years, a significant increase in the total of non-oil or gas-fired boilers, i. e. those firing coal and by-product and refuse fuels, has occurred; from a 1972 figure of 22.7% 1976 sales of these units were up to 34.0% (See Exhibit "D"). Furthermore, not a single large (input greater than 300 million Btu per hour) industrial oil or gas-fired boiler was sold in 1976.* Looking to the future, industrial boiler inquiries of oil and gas-fired units are running only about one-third of the total. In corroborating this trend a leading industrial boiler consulting firm reports no gas-fired and only 10% oil-fired boiler inquiries.

While an exact determination of total U. S. steam generator manufacturing capacity has never been made, industry estimates range from 20 - 30,000 megawatts coal-fired utility units and 6 - 7,000 megawatts coal-fired industrial units. We believe this capacity is adequate to respond to any credible national coal conversion schedule.

D. NEW TECHNOLOGY; TIMETABLES

The need to reduce our dependence on oil and gas as boiler fuel, whether it be for power generation or industrial steam production, has precipitated a drive to develop advanced coal burning technologies and coal-derived synthetic fuels. Active research and development projects are underway in the following fields:

- a. Fluidized bed combustion;
- b. Coal/oil slurry mixtures;
- c. High Btu coal gasification;
- d. Low and medium Btu coal gasification;
- e. Liquefied coal, solvent-refined processes.

*Note: A large number of these units have been sold in recent years:

1975 - 21
1974 - 54
1973 - 45

We believe it will be at least 3 - 5 years before sufficient data from demonstration plants is available to indicate which of these processes, if any, are practical for commercial steam generation. It could be another five years before a substantial number of these high technology units were installed.

For the next five or six years, then, we must depend on existing coal technology, i. e. the use of stoker and pulverized-coal firing.

TECHNICAL CONSIDERATIONS

Fuel Oil and Natural Gas Consumed in Boilers

<u>Heat Input, MKB</u>	<u>Barrels of Oil (or oil equivalent)</u> <u>Per Day</u>
10 - 100	2.0 million
101 - 300	0.6 million
Over - 300	1.6 million
Total Industrial	4.2 million
Total utility	2.8 million
GRAND TOTAL	7.0 million

1. New utility boilers should be designed to burn coal;*
2. Below a specified size industrial boilers should be designed to burn oil; if individual plant economic and environmental considerations permit, an installation should be designed for coal firing;
3. Above this size industrial boilers should be designed to burn other than oil or natural gas; this will be coal, industrial by-product fuels and refuse;*
4. WE STRONGLY URGE THAT FEA NOT BE GIVEN THE AUTHORITY TO LOWER THIS LIMIT IN SPECIFIC INSTANCES FOR "PUBLIC INTEREST" REASONS; OTHERWISE, THE UNCERTAINTY SYNDROME WILL BE PERPETUATED.
5. Operators of utility or industrial boilers should be encouraged to convert from gas to oil-firing, but smaller industrial users should retain their gas capability for the following reasons:
 - a. Maintenance plant operation in the event of oil embargo;
 - b. Non-availability of oil in some areas;
 - c. Capability to use synthetic gas if it becomes available.
6. Consideration should be given to extension of the 1990 oil-use cut off date to 1995, permitting a more deliberate phasing-in of coal as a boiler fuel.

*We believe the utilization of industrial by-product and refuse fuels should be strongly encouraged not only to reduce oil and gas consumption but to conserve the Nation's coal resources as well. While a majority of these applications will be in the industrial sector there will be utility applications, too.

SUMMARY

Conflicting and confused signals from Washington in the closely related energy and environmental areas have cast a pall of uncertainty over U. S. industry and utilities; inaction is the inevitable result. New orders for steam generators in 1976 and so far in 1977 are running less than 1/3 of normal, i.e. at about the level of the 1930's. THIS MEANS THE NATION'S COAL CONVERSION PROGRAM IS STALLED. Legislation enacted must, therefore, reflect a policy which is clear, consistent and predictable over the period it is designed to affect. To prolong this uncertainty will cause grave damage to the Nation's energy supply.

Therefore, we urge rapid enactment of reasonable coal conversion legislation.

Exhibit "A"

Available industrial fuels—gas, liquid and solid

Gas	Btu/cu ft, as-fired	Liquid	Btu/lb, as-fired	Solid	Btu/lb, as-fired
Natural gas	1000	Gasoline	20,700	Coal	7000-14,000
Coke-oven gas	500-600	Naphtha	20,250	Bagasse	3600-6600
Blast-furnace gas	85	Naphthalene	18,500	Bagasse	3600-6600
CO gas	20-30	Industrial sludge	3700-4200	Bark	4500-5200
Refiner gas	1200-1800	Black liquor	4400	General wood waste	4500-6500
Waste organic gases	Variable	Sulfite liquor	4200	Sawdust, shavings	4500-7500
		Dirty solvents	10,000-18,000	Coffee grounds	4900-6500
		Spent lubricants	10,000-14,000	Nut hulls	7700
		Paints and resins	6000-10,000	Rice hulls	5225-6500
Liquid	Btu/lb, as-fired				
Crude oil	19,200	Oil waste, fuel-oil		Corn cobs	8000-8300
Residual oil	18,500	residue	18,000	Municipal refuse	4500-6500
Distillate oil	19,300	Waste organic liquids	Variable	Industrial refuse	6600-7300

Exhibit "B"

Exhibit "C"

Exhibit "D"

FUELS FIRED, INDUSTRIAL BOILERS

<u>% by capacity</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
GAS, OIL	77.3	71.5	73.7	68.3	65.6
WASTE FUEL, WASTE HEAT, COAL	22.7	28.5	26.3	31.7	34.4

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Mr. DINGELL. Thank you, sir.

The Chair recognizes the gentleman from Michigan, Mr. Stockman.

Mr. STOCKMAN. Mr. Forman, I would just like to clarify one thing for the record before we get started because I must have misunderstood you or not heard you correctly, but did you indicate that the FEA has issued a NOI which would require you to convert a wood-fired boiler to coal? Did I misunderstand you, or is that what you said?

Mr. FORMAN. FEA has issued us a NOI for two boilers at one plant, and one of these boilers burns wood all the time to the extent of its capacity with, say, maybe 20 to 25 percent of supplemental fossil fuel which used to be gas and now is oil.

[The following clarifying note was received for the record:]

(It is not presumed that FEA would ask Scott to diminish or to eliminate the amount of wood and bark burned in these boilers and to replace it with coal, but rather to replace the supplemental oil or gas with supplemental coal. The conversion of the supplementary fuel would have an extremely high cost and provide very little benefit).

Mr. STOCKMAN. But the baseload on it is wood?

Mr. FORMAN. In effect it is full of wood practically.

Mr. STOCKMAN. Did they ask you for information about that boiler before they issued a NOI or what did they base it on?

Mr. FORMAN. Two or three times.

Mr. STOCKMAN. And you indicated it was 75 percent wood-fired?

Mr. FORMAN. Yes. Wood is the primary fuel.

The second one at that same installation, just to make it abundantly clear, is not burning wood most of the time, but when boiler number one, the wood boiler, goes down, as it must for many days a year, the other one has to pick it up or we would be covered up in bark. It is very essential to have that boiler 100 percent available.

Mr. STOCKMAN. So that is really the way you dispose of your waste product, to keep it moving into your boilers?

Mr. FORMAN. Right.

Mr. STOCKMAN. I indicated this morning to Mr. O'Leary that I had some concern about his unleashing his agency into the industrial sector of the economy to make all kinds of orders on what types of fuels ought to be used for what end uses and processes, and perhaps we have a fairly good example here of the danger that some of us anticipate.

Mr. FORMAN. I do not understand why this was issued.

Mr. STOCKMAN. Thank you.

Another area that I wanted to get into was this with Mr. Marx. We had one of the leading environmental experts in the Nation here this morning, the head of the Environmental Protection Agency, and he seemed to indicate that NOx control for large utility and industrial boilers was pretty much a frontier area as far as scientific and technological understanding was concerned, and so we really didn't have much of a basis for estimating costs or coming to any conclusions as to how feasible NOx control would be from stationary sources.

You are in the business, in the industry, and I wonder whether or not that is an accurate reflection of the state of affairs and whether

or not there is some information you could provide either for the record or now which would add to what we know?

Mr. MARX. No, I don't believe that is accurate, Mr. Stockman, and to respond to that I think in a little more detail I would like to call Mr. Robert Welden of Foster Wheeler.

Mr. DINGELL. Would you please identify yourself?

Mr. WELDEN. My name is Robert Welden. I am with Foster Wheeler Energy Corporation. In the present state we are controlling NOx from large coal-fired units. I think one of the main problems is that we don't know what some of the side effects of it might be, but right now we can meet compliance with the .7 pounds per million Btu. Costwise for a unit designed today to meet the environmental .7 pounds per million Btu it did not add a tremendous amount to the cost, but as I say, we still do not know what the side effects may be in the long term and, therefore, it may be that we will have to reduce the output of a steam generator in order to comply without getting the steam generator into other difficulties.

Mr. STOCKMAN. Maybe you can give a little more background on that specific point. As I understand it, NOx is a product of the combustion process rather than the fuel unit used. I would presume then when you are trying to control NOx you are really trying to calibrate the combustion process some way. Is that what you are referring to?

Mr. WELDEN. Yes.

In other words, with oil and gas firing the largest percentage of your NOx formed is the thermal NOx which is a nonorganic form of nitrogen oxide formation. In coal firing the largest percent formed is from the fuel in the nitrogen in the fuel itself which is an organic form. We still do not entirely understand what the process of formation is of the fuel nitrogen. The thermal emissions from coal firing are relatively low so that this can be very easily controlled by the same process as we use on oil and gas.

Right now we are all working, I believe, to modifying the type of combustion in order to limit the transformation of the fuel nitrogen to NOx, but this is definitely not in a very progressive state right at the present time. We have had mixed experience with it.

Mr. DINGELL. The time of the gentleman has expired.

The Chair recognizes the gentleman from Ohio, Mr. Brown, for five minutes.

Mr. BROWN. Thank you, Mr. Chairman.

Gentlemen, the U.S. Chamber of Commerce points out that there are three types of costs imposed by this program that has been known as the National Energy Act. First is direct taxes, and that some of these will be rebated. Second is inflation taxes, as inflation due to the program pushes people into higher tax brackets and the Government is going to be collecting somewhere between \$15 billion and \$20 billion a year more from individuals by 1984, but there is no plan to rebate that tax. Then, finally, the slower growth of the gross national product will reduce the growth of wages over the years, and the sum total of lower wages and the inflation taxes come to about \$1,000 per worker each year by 1984, and then goes up after that.

Can you speak to the figures that were given by the Treasury Department with reference to various industries, particularly the paper industry? They gave quite a broad range there of what that inflationary impact would be. Do you concur with that? I am trying to find that. I think it was 2.7 to 7.0 or something like that in terms of inflation percentage.

Mr. FORMAN. I am sorry, I cannot comment on that personally, but I am sure the American Paper Institute could supply an answer to that later.

Mr. BROWN. I wonder if we could get that for the record because I am concerned specifically about whether those inflation figures or impact figures given by the Treasury were rational in terms of impact on the industry.

Mr. MORRISSEY. In connection with our testimony before the Ways and Means Committee we took the oil tax the user surcharge on the man-made fiber, and then the user tax that would be levied on the manufacturing of our textile products and we come up with a figure of \$430 million.

Mr. BROWN. The figures for the paper industry were 1.7 to 2.6. I guess it was in the aluminum industry it was 4.7 to 7.0, and the petrochemical industry was 6.2 to 9.3.

Does anybody want to comment further on those?

Mr. MORRISSEY. We had simply a gross dollar figure as to what it would cost the textile industry.

Mr. BROWN. Can you try to quantify some of those figures into percent? Let's see what they say about the textile industry here. They don't list it—

Mr. MORRISSEY. We are not among the top six. We are among the top ten. I think they listed the top six.

Mr. BROWN. Yes. I wonder if you could get us figures for yours and any other appropriate industry? I wonder if the petrochemical industry could?

Mr. TWOMEY. I don't have the information, but I will get it for you.

Mr. BROWN. In terms of the feedstock versus boiler fuel figures, do any of you have a percentage for the total industrial use of natural gas, as to how much of it is feedstock and how much of it is boiler fuel?

Mr. MORRISSEY. We are in the process of developing that for the Ways and Means Committee which also requested it, and we would be happy to supply it to your committee. We are currently running a survey of our industry to find out exactly what our process use is and what our boiler fuel is and we should have that by next week.

[The following information was received for the record:]

An informal survey of textile manufacturers indicates that most of the natural gas being consumed is for process use for which there is no substitute. Consumption of natural gas by individual companies varies, depending upon the products being made, and the availability of natural gas. Process use amounts to anywhere from 30 to 100 per cent. There is some nonprocess use, particularly during summer months, simply because natural gas has been available. However, this situation is changing as gas supply becomes tighter and manufacturers need to save what gas is available for those processes for which there is no substitute.

Mr. BROWN. I wonder if you could also provide it for us and then if you could also give us the impact of the process fuel use in terms

of product price increases. Do you have that in the various industries, any of you have it in the various industries represented? Because that tax apparently will be passed right on through to the consumer directly and there is no prospect of it being rebated. Isn't that the way the program will work? Petrochemical, do you want to comment on that?

Mr. TWOMEY. Again I cannot comment but I can obtain the information.

Mr. BROWN. Isn't that the way the program will work?

Mr. TWOMEY. Yes.

Mr. BROWN. In other words, you will be taxed for the natural gas usage. That you cannot avoid, can you?

Mr. TWOMEY. Right.

Mr. BROWN. Is there any way you can avoid or cut down natural gas usage in any of your processes in the petrochemical industry that you can think of?

Mr. TWOMEY. I cannot speak with a great deal of expertise on that point.

Mr. BROWN. Has the industry done any study, and I might ask that also of the textile industry.

Mr. MORRISSEY. We have some and we are doing it where it can be done. In one case, for instance, there has been a recent breakthrough where we find that we can use No. 2 fuel oil where we were formerly using natural gas, but because the user charge applies to fuel oil as well as natural gas we still face the user charge on No. 2 fuel oil.

Mr. BROWN. Aren't you out of the frying pan into the fire?

Mr. MORRISSEY. In that case certainly, yes. Then we have certain processes where we need an open flame such as singeing, and we have no choice but to keep using gas and pay the surcharge.

Mr. BROWN. Finally, I wonder if you would submit for the record in each of the industries represented the trend of construction of plants in gas-available areas and gas-short areas? I am particularly interested in the petrochemical industry and the paper industry, and I wish the glass industry were represented, to know whether they are tending to move south in order to get an assured, although more expensive, supply of natural gas for their process uses.

[The following information was received for the record:]

There is no trend as yet in the textile industry toward locating plants because of energy considerations, although as supply becomes more critical this could become a future consideration.

Mr. BROWN. Does anybody want to speak to that?

I am finished.

Mr. DINGELL. The time of the gentleman has expired. Without objection the information requested will appear in the record at the appropriate place.

The Chair recognizes counsel for purpose of asking questions.

Mr. BARRETT. Mr. Forman, I understand from your testimony that perhaps the FEA picked the wrong plants to issue the NOI's to. Are you going to offer to trade them?

Mr. FORMAN. We are just entering the hearing stage on these. One was yesterday, and one is coming up next week, and we hope to learn there why they picked these plants. I don't know.

Mr. DINGELL. It does strike me on the plants in question they could have done rather better.

Mr. BARRETT. Mr. Twomey, you mentioned that Texas Railroad Commission Docket No. 600. Does this requirement to use fuel other than oil and gas relate to refineries as well as to normal processes?

Mr. TWOMEY. Only for the firing of the boilers.

Mr. BARRETT. But it does apply to refinery boilers as well?

Mr. TWOMEY. Yes.

Mr. BARRETT. On page 2 of your statement you talk about the complex where you spent something in excess of \$70 million to convert from gas to coal, and you haven't increased your productivity or your production capacity?

Mr. TWOMEY. Capacity.

Mr. BARRETT. Have you increased the life of the facility at all?

Mr. TWOMEY. I suppose you could say that because they are new boilers, but not the manufacturing process themselves.

Mr. BARRETT. Could you give us an indication of how long you might have increased the life? Is it 10 percent, 20 percent, or is it quantifiable?

Mr. TWOMEY. I cannot say that. I can check it for you though and let you know.

Mr. BARRETT. Would you please?

Mr. TWOMEY. Sure.

Mr. BARRETT. Does this \$70 million figure include scrubbers?

Mr. TWOMEY. No, it doesn't.

Mr. BARRETT. That would be another increment, something beyond that?

Mr. TWOMEY. Yes.

Mr. DINGELL. Does it include any other pollution control or safety equipment?

Mr. TWOMEY. Those to be in compliance with the Texas Air Quality Board.

Mr. DINGELL. It does include.

Mr. TWOMEY. Yes.

Mr. DINGELL. I see.

Mr. BARRETT. Mr. Marx, when you convert a boiler from oil to coal essentially you have to rebuild the boiler as I understand it. In the process of rebuilding do you end up derating the boiler?

Mr. MARX. Well, if you were to go that route you would have to derate, yes. What we say is the derating could be as much as 70 percent and the cost could be as much as 75 percent, the cost of a new unit, so it just doesn't make sense. That is why we said it is really a boiler replacement, going from either gas or oil-fired to coal-fired.

Mr. BARRETT. You lose that much.

Mr. MARX. There is one point perhaps should be mentioned here that wasn't talked about this morning by the ERDA witness, and that is ERDA has a program, and they recently let something in the area of five or six contracts to study the combustion of coal-oil slurry. This is a mixture of up to I guess as high as 50 percent coal and 50 percent oil with some sort of a stabilizing agent so that it is a mixture which remains stable and can be handled like oil. Preliminary indications are—this will be pulverized coal—that the boilers

operate very well, that the flame is very much like an oil flame, and a couple of the problems that the boiler manufacturers foresaw with the limited experience to date may not be too serious, so this might be a way for certain smaller industrial boilers of the type that I described as being nonconvertible to burn some coal. It is a little too early to make any judgments, but the indications so far are somewhat favorable. I think there should be some reference to coal-oil slurry in your record here.

Mr. BARRETT. You did testify with respect to the 100 million Btu limit and expressed some concern that the FEA could reduce that limit further. I am concerned about the 100 million to some upper number like 300 million. How realistic is 100 million Btu's as a lower limit for a boiler? How many people would be employed in the plant that would use that kind of a boiler, for instance?

Mr. MARX. It would depend on the type of plant, but let me go back. We don't have unanimity of opinion in the Association on this point, the reason I didn't put it in here officially, but our consensus is, and I believe that this is in agreement with most of the industrial users that I have spoken with, that an input something in the area of 250 million to 300 million might be appropriate.

I want to make the distinction between what is done by Government requirement and what is done in the natural economic course of events. We hope to see a lot of coal-fired units and sizes below 250 or 300, below 100, below 50, and so on, and there are indications where this is possible it is happening. We have a list, for example, of 12 companies that makes stokers, coal-firing equipment, for industrials, that we had either never heard of or we thought had gone out of business that are back in business. We have three companies in ABMA who manufacture very small boilers, much smaller than what we have been talking about here, where there is appreciable market for these coal-fired units. In the case of one firm 40 percent of their shipments are for coal-fired units, so I am trying to draw the line between what we perceive to be happening and perhaps about to happen in the free marketplace.

There will be a lot of small coal-fired units we think, but in terms of legislation and FEA, I would think that our consensus would be a limit of 250 or 300 million floor per unit, and I don't particularly like the idea of a combination criterion of x size per unit and y size per plant, because then you do what you want to do while using multiple units. I don't think that really makes a lot of sense, so I would think a one unit designation would be appropriate.

Mr. BARRETT. Well, if you had an overall plant size, a maximum or minimum, such as 300 million would you prevent somebody from putting in five units of 95 million Btu?

Mr. MARX. Yes, but, for example, if you had 100 million per unit, as I think is in the bill, and 250 per plant, your steam requirement is anywhere in between those two extremes, for example, suppose I have a requirement for 240 million. I can put in three 80 million units. I am below the 100 per unit, and I am below the 250 per plant, so the guy is making the decision. If you are going to do that, why not let him do it in the first place? That was my point.

The other point you should make is it is a little bit hard to draw any correlation between the size of the boiler unit and the number

of people employed. You have to know what kind of industry you are in. The gentlemen represented here at this table are people whose plants basically are process plants, and they use a lot of steam, and it doesn't mean that there are a tremendous number of people in the plant. Auto assembly lines, like General Motors, many of their plants are below 100 million, but of course in some cases they have tens of thousands of workers and that is because their load is strictly heating. They have no process requirements.

Mr. BARRETT. We heard testimony the other day that would indicate there was as much as a 7-year backlog on industrial boilers. Does that sound realistic?

Mr. MARX. It is totally false. We can produce in the industry, using the historical fuels pattern, and recognizing a coal-fired boiler is larger, therefore, in terms of megawatt or input capacity, we can produce fewer or less aggregate capacity coal-fired than oil or gas-fired, so taking the traditional fuel pattern we have produced up to 90,000 pounds of steam per year in aggregate industrial boiler capacity. That was in 1973. In 1974 our orders ran 74 million. In 1975 they dropped down to around 50 million. In 1976 they were 38 million. This year they are running at an annualized rate of about 40 million. So you can draw your own conclusions. We are down about two-thirds of our normal capacity. So somebody is very badly misinformed.

Mr. BARRETT. Thank you, Mr. Chairman.

Mr. DINGELL. Mr. Brown.

Mr. BROWN. Mr. Chairman, I would like to ask, we are sitting here discussing the wisdom of the FEA of requiring Scott Paper to change a wood-chip boiler to coal-fired—is there anybody else here from Scott? I would like to find out from the record or maybe ask counsel or ask FEA what opportunity there was for the paper company to appeal that decision. If any of you were obliged to change your boiler by FEA, would you have the choice to take it to an appeal or what would you do? Take it to court? How would Scott have been able to avoid that decision which seems to me to be, on the face of it, ridiculous, to be kind.

Mr. MORRISSEY. As I understand it, this is a notice of intent. There is a hearing procedure where they can bring in their case and point up the criteria on which it is based. There is a notice of intent, an opportunity for a public hearing and an order to do so if they find it is justified. So there is an administrative procedure which permits you to be heard but it is a rather long and expensive procedure when you see they are hitting a boiler they should not have been looking at. The boiler is already in place and in use. They are questioning as to why that was looked at.

Mr. MARX. If I may call on our association counsel, Mr. Miron.

Mr. MIRON. You have a company who is being regulated, then having to go through a regulatory process, then ultimately through a judicial process in order to purchase a piece of equipment. This goes to this issue which was brought up earlier today as to where the procedural burden should be. As it is under the law now, the burden is upon the agency to take the would-be purchaser.

Mr. BROWN. At present?

Mr. MIRON. Yes. The existing law would change that. It would require going to court to justify buying a piece of equipment which

would be an extraordinary procedure considering most of the time you don't have a lot of lead time. And you would have to get some kind of injunction under some kind of threat that if it were wrongfully issued, you might have to tear out the equipment. You have put your finger on an important procedural part of the program.

Mr. BROWN. You have a lot of little companies which would wind up being part of bigger companies if they had too many of those legal procedures they had to undertake. It is awfully tough for a small business to do that kind of battle with a monstrous agency like FEA.

Mr. MIRON. We have been talking in terms of utilities in industrial companies but it should be remembered that the customers for steam generating equipment in the lower ranges of 100 million Btu content in universities, hospitals, in buildings such as the Capitol of the United States—

Mr. BROWN. I think we could hold out.

Would you give us that breakdown—do you have that—of the customers for the different sizes of boilers at different levels? The kinds of people involved?

Mr. MARX. I would rather get the information and submit it for the record.

Mr. BROWN. Yes. I would also like to ask you for some detail on the study that brought you to the conclusion—I beg your pardon. This is the testimony of American Textile Manufacturers Institute citing their study that the American Boiler Institute has estimated the total replacement cost for units would be \$49 billion, exclusive of the cost of pollution control equipment.

Mr. MARX. We will submit that for the record.

Mr. Dingell. Without objection.

Mr. BROWN. I assume, therefore, that you have a fairly extensive study that has different statistical data.

Mr. MARX. We have a matrix which shows the material you refer to.

Mr. BROWN. Thank you, Mr. Chairman.

Mr. DINGELL. Mr. Stockman.

Mr. STOCKMAN. Mr. Marx, when we were discussing before the fluidized bed process, you estimated it would be 10 to 15 years before it was adopted in the utility sector. The reason was there was a scaling-up time involved and the chairman asked you what that was based on and you said, "Our experience with conventional boilers has shown that." Would you submit some data showing the historical process in terms of the growth and boiler size so we can see over what time period this scaling-up is for the utility boilers we have today. Obviously, it took a lot of operating experience, testing and experimentation to get those large size boilers. Would you comment on that?

Mr. MARX. I will put the data together for the record. But one point that should be made, that is the extreme variability of fuel. As you go out and use the newer coals out west, that situation worsens. So you have appreciable differences in fuel that comes out of the same mine.

Mr. STOCKMAN. What you are saying is that when you get to low-quality fuel, you have all kinds of problems with very large boilers and combustion processes.

Mr. WELDEN. You spoke of before the extrapolation of the first steam generators. Yes, this has been rapid, in fact, too rapid. Right now the utilities are under the pressure of FEA and so forth in an effort to improve their reliability. In the fluidized bed it is a relatively new technique and we still do not know what the broad range of characteristics will have on it. There is a great deal of experimentation that has to be done.

Mr. MARX. It is an entirely different combustion process in itself.

Mr. STOCKMAN. If we could go back to conventional boilers and total coal combustion processes. When you take into account waste disposal and so forth, it seems to me it is an important thing to know whether you could get very large economies and that would call for direct coal combustion, but if you get to the lower end and the cost rises rather steeply you might want to consider more ways to put more gas into the pipelines. Is there any good information available on that? Can you give us some comments or maybe submit something for the record?

Are there economies of scale in coal combustion treatment or emission control? As I understand it, when you are talking about the stack scrubbers you are really talking about a mini-chemical plant. For fairly small boilers, I am wondering whether you could even put on a stack scrubber which could be justified in any sense in terms of cost factor ratios. If there are economies of scale for both, do they coincide?

Mr. MARX. One of the basic things when you speak of putting a scrubber on a boiler, it takes as much manpower to operate a small boiler as it does a large one.

In coal handling equipment, it is very similar. There is a certain amount of basic expense associated with it. The coal piling and handling facilities, the preparation of fuel, the pulverizing and so forth and a stoker-fired unit has limited capacity, so when you get into the 5 million Btu and above you are forced to go to pulverization in the fuel. The stoker-fired jobs require less equipment but the first costs may be quite high. It is also true the steam generator and all the other equipment is definitely more proportionate, the smaller you get. There are certain basic costs, so the 500 megawatt steam generator as compared to a thousand watt, is cheaper.

Mr. STOCKMAN. Would you submit for the record something which would show the output capacity in terms of power and steam and the costs both capital and operating costs.

Mr. DINGELL. The Chair recognizes the minority counsel.

Mr. VLCEK. Mr. Twomey, with respect to your trying to obtain transportation of coal to certain areas, we have testimony from the Association of American Railroads in which they indicated they felt they had the full capacity to handle this coal movement and they have been told up to 72,000 coal cars per year could be built.

Have you perceived in your attempt to arrange to purchase these coal cars that perhaps this capacity is not there? Perhaps there may be some problems?

Mr. TWOMEY. The other seven firms said they would decline to bid on the trains for the coal.

Mr. VLCEK. Any reason?

Mr. TWOMEY. Most had little or no experience in building the car. They are automatically unloaded and automatically closed. They didn't have the experience for this type of car but this is the car which will be used to haul most of the western coal. It will be used in unit trains. It is a rapid discharge car. The bottom gates pass through a beam and they are automatically unloaded. The train itself never stops moving. It passes over a trestle and when it passes the beam it is automatically unloaded.

Mr. VLCEK. If this coal is to be moved by unit train, it may be that the experience to move these cars may not exist.

Mr. TWOMEY. That is right.

Mr. BROWN. What are the cars made of?

Mr. MARX. Steel.

Mr. VLCEK. What kind of steel?

Mr. MARX. The alloy—

Mr. BROWN. Is there any problem in getting the steel for boilers, including the tubing?

Mr. MARX. It is basically tubular and plate products.

Mr. BROWN. You mean plate steel?

Mr. MARX. Yes. Very, very heavy plate up to 10 or 11 inches in thickness.

Mr. BROWN. The reason I worry is that it takes plate steel to make railroad cars, to make barges, boilers, mining equipment, drilling equipment.

Mr. MARX. The kind of plate we use comes from users not in the markets you mention. The speciality people who make our plate, which is very heavy, are not involved in making the kind of plate you are talking about, by and large.

Mr. BROWN. How many producers? If you could find out and let us know for the record and ask them whether there is any problem with that, I would appreciate that being submitted for the record.

[The following letters were received for the record:]

AMERICAN BOILER MANUFACTURERS ASSOCIATION

SUITE 317 AM BUILDING 1500 WILSON BOULEVARD, ARLINGTON, VIRGINIA 22209 703/522-7298

June 3, 1977

Congress of the United States
House of Representatives
Subcommittee on Energy and Power of the
Committee on Interstate and Foreign Commerce
Washington, D. C. 20515

Gentlemen:

I have checked our data for boilers with a capacity in excess of
80,000 #/hr steaming capacity (equivalent to an input of 100 MKB)
with the following results:*

<u>Oil and Gas</u>		<u>Coal and Waste</u>
50%	1977	50%
53%	1976	47%
60%	1972	40%

* On a capacity basis

I would like to have this information included in the record of the
hearings on H. R. 6831.

Sincerely,

Wm. B. Marx
William B. Marx
Executive Director

WBM/rd

~~A B~~
~~M A~~

AMERICAN BOILER MANUFACTURERS ASSOCIATION

SUITE 317 AM BUILDING

1500 WILSON BOULEVARD, ARLINGTON, VIRGINIA 22209

703/522-7298

June 3, 1977

Congress of the United States
House of Representatives
Subcommittee on Energy and Power of the
Committee on Interstate and Foreign Commerce
Washington, D. C. 20515

Gentlemen:

I would like to have the following American Boiler Manufacturers Association
data included in the record of the hearings on H.R. 6831.

Average Size Industrial Boilers by User Industry, June 2, 1977

Sales of Industrial Type Watertube Steam Generators -
Distribution as to Markets - 1972 through 1976

Increased Size Electric Utility Generating Units, June 2, 1977

Sincerely,

Wm. B. Marx
William B. Marx
Executive Director

WBM/rd

P. S. Enclosed also is: Boiler Plants Designed for Oil or Gas Firing
Other Than Electric Power Plants, June 3, 1977

~~A/B~~
~~M/A~~

AMERICAN BOILER MANUFACTURERS ASSOCIATION

SUITE 317 AM BUILDING 1500 WILSON BOULEVARD, ARLINGTON, VIRGINIA 22209 703/522-7298

**AVERAGE SIZE INDUSTRIAL BOILERS
BY USER INDUSTRY**

	<u>1976</u>	<u>1975</u>	<u>1974</u>	<u>1973</u>	<u>1972</u>	<u>AVER.</u>
PAPER	220,000	247,100	193,800	151,700	245,700	211,700
PETROLEUM	94,700	248,600	183,800	188,500	180,800	175,300
PRIMARY MET	200,000	144,000	148,000	98,600	110,000	139,700
CHEMICAL	139,100	111,800	180,800	117,900	104,700	126,800
WOOD	127,300	285,700	75,600	80,300	57,700	125,300
ELECT. UTIL. (non-gen.)	93,500	114,300	131,250	105,500	127,700	114,500
RENTAL	91,700	90,000	108,400	*	*	96,000
TRANSPORTATION	66,700	133,300	95,000	65,500	81,100	84,300
FOOD	100,000	91,700	75,000	78,600	65,700	81,800
SCHOOLS	50,000	90,000	72,200	53,100	67,200	68,500
MISC. MFG.	59,000	66,700	57,600	82,700	68,000	66,400
NON-MFG.	58,100	46,400	65,800	55,400	71,400	59,500
TEXTILES	69,200	55,600	45,800	60,600	48,800	55,600
RUBBER	45,000	60,000	55,600	60,700	58,250	55,500
MEDICAL	28,200	27,800	37,500	31,700	32,700	31,400
AVER. IND.	85,800	98,500	103,100	88,400	81,800	91,100
AVER. COAL	100,000	118,200	144,700	171,800	280,000	162,800

* Included in non-manufacturing classification.

rd

1972 SALES OF INDUSTRIAL TYPE WATERTUBE STEAM GENERATORS
DISTRIBUTION AS TO MARKETS

Number of Units	Market Category	Total Capacity (million PPH)
52	Petroleum	9.4
86	Chemical	9.0
35	Paper	8.6
112	Non-Mfg.	8.0
99	Food	6.5
47	Elec. Util. (Non-Gen.)	6.0
	Medical	4.8
64	Schools	4.3
50	Mis. Mfg.	3.3
62	Textiles	2.9
26	Wood	1.5
10	Metals	1.1
18	Transportation	1.1
16	Rubber	0.9
Total Number of Units 824		Total Capacity 67423 thousand PPH

Note 1: This section includes all industrial type units, steam, packaged and field-assembled, regardless of use, both domestic and export.

Note 2: Schools includes schools and colleges; medical includes hospitals, medical centers and related facilities. These categories were formerly included in the Non-Mfg. group.

A B
M A

AMERICAN BOILER MANUFACTURERS ASSOCIATION

SUITE 317 AM BUILDING 1500 WILSON BOULEVARD, ARLINGTON, VIRGINIA 22209 703/522-7298

**INCREASED SIZE
ELECTRIC UTILITY GENERATING UNITS**

	TOTAL UNITS	TOTAL CAP. X 10³	AVG. SIZE X 10³	COAL UNITS	COAL CAP. X 10³	AVG. SIZE COAL X 10³
1961	82	98,390	1,200	45	59,780	1,328
1962	84	76,937	918	44	53,000	1,205
1963	71	110,629	1,558	32	49,500	1,546
1964	86	134,394	1,562	30	52,600	1,753
1965	77	169,637	2,203	47	127,700	2,717
1966	73	164,169	2,249	42	117,500	2,798
1967	72	198,306	2,754	32	109,700	3,428
1968	79	189,559	2,399	29	102,400	3,531
1969	65	198,931	3,061	29	139,200	4,800
1970	79	234,122	2,963	22	83,000	3,773
1971	64	141,525	2,211	21	64,000	3,048
1972	58	153,618	2,649	20	68,200	3,410
1973	70	243,126	3,473	50	200,700	4,014
1974	90	276,929	3,077	72	263,600	3,661
1975	32	115,643	3,614	28	114,200	4,079
1976	19	49,827	2,622	13	47,500	3,654

Note:

1962 to 1969 Average size of all units increased 294%
Average size of coal units increased 306%

B
A

AMERICAN BOILER MANUFACTURERS ASSOCIATION

SUITE 317 AM BUILDING 1500 WILSON BOULEVARD, ARLINGTON, VIRGINIA 22209 703/522-7298

BOILER PLANTS DESIGNED FOR OIL OR GAS FIRING OTHER THAN ELECTRIC POWER PLANTS

Lower Plant Specified Heat Rate Level (1) (Million Btu Input)	120	300	Over 300
Non-Solid Fossil Fuel Consumed Per Day - Million Bbl Oil Equivalent (2)	2.2	2.0	1.6
Estimated Number Units Requiring Replacement (3)	17,000	4,000	400
Cost Coal Fired Plant \$/1000 Btu	80	57	40
Costs Coal Fired Plants \$/Plant	8 million	14 million	21 million
Estimated Number of Plants Requiring Replacement	7,000	2,000	300
Total Replacement Costs Coal-Fired Plants \$	56 billion	28 billion	6.3 billion

(1) Boilers installed in what might be considered combinations

(2) Consumption as boiler fuel; excludes other non-boiler uses

(3) ABMA Analysis

Revised 6/3/77

DFT-6-132-77

June 17, 1977

Mr. John D. Dingell
 Chairman
 Subcommittee on Energy and Power
 U.S. House of Representatives
 Room 3204 - Annex #2
 2nd and D Streets, SW
 Washington, D.C. 20515

Dear Congressman Dingell:

On Friday afternoon, May 27th, I appeared before your Subcommittee as an industrial transportation expert on a panel of witnesses drawn from major industrial users of energy. Following the panel's testimony, members of the Subcommittee raised several questions which although related to the petrochemical industry were outside the scope of my transportation specialization. I have since discussed the questions with responsible individuals within Celanese in an attempt to be responsive to the members' questions.

On information and belief, I know of no industry figures which support Dr. Laurence N. Woodworth's testimony, which testimony, I believe, is based on White House information that the inflationary impact of the President's coal conversion program would be between 6.2 and 9.3 percent.

A Subcommittee member asked for comment on his observation that natural gas for feedstocks is non-substitutable and hence, feedstocks use by petrochemicals is not like boiler fuel use of natural gas which is substitutable. The member is correct. Petrochemical feedstocks are unique and technology unfortunately does not permit petrochemicals to be made out of some feedstock other than oil and gas. In existing plants, only the feedstock for which the plant was designed can be used. For new plants, a limited shift to crude oil fractions for feedstocks rather than gas is possible. But the use of coal as a feedstock is, perhaps, 20 years off, if then.

A member brought up the trend in plant construction asking if new plants were going into gas short or gas normal areas. We cannot speak for the rest of industry but only for ourselves. Because of the importance to our industry of raw materials from natural gas processing plants and refineries, the heaviest concentration of petrochemical plants is along the Texas and Louisiana Gulf Coast. Although regional raw material availability is an important consideration, feedstock costs have been and will continue to be determinate in locating petrochemical complexes either here or abroad.

Very truly yours,

A handwritten signature in cursive script that reads 'Daniel F. Twomey'.

DANIEL F. TWOMEY
 DIRECTOR OF TRAFFIC
 CHEMICALS GROUP

DFT:dmm

Mr. DINGELL. Gentlemen, you have been here for a long time. We thank you.

The committee stands adjourned until Wednesday morning at 10 o'clock.

[The following memorandum, statements, and letters were received for the record:]

NINETY-FIFTH CONGRESS
JOHN D. DINGELL, MICH., CHAIRMAN
RICHARD L. OTTINGER, N.Y.
ROBERT (BOB) KRUEGER, TEX.
PHILIP R. SHARP, IND.
ANTHONY TONY MOFFETT, CONN.
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(EX OFFICIO)

CONGRESS OF THE UNITED STATES
HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON ENERGY AND POWER
OF THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE
WASHINGTON, D.C. 20515

ROOM 2204
HOUSE OFFICE BUILDING ANNEX NO. 2
PHONE (202) 225-1030

May 25, 1977

M E M O R A N D U M

TO: Chairman John D. Dingell
FROM: Subcommittee Staff
SUBJECT: Coal Conversion Program

On March 25, 1977, you asked the staff to evaluate the performance of the Federal Energy Administration's coal conversion program, conducted under authorities granted by the 1974 Energy Supply and Environmental Coordination Act (ESECA), as amended by the 1975 Energy Policy and Conservation Act (EPCA). The review you requested was occasioned by the fact that authority to issue prohibition orders under these statutes is scheduled to expire June 30. Subcommittee investigators subsequently obtained and analyzed more than 400 documents generated by FEA and the Environmental Protection Agency (EPA) over the three years of the coal conversion program and interviewed 23 present and former program officials at both FEA and EPA. In addition, one Subcommittee staffer attended an FEA regional hearing on coal conversion in Boston and, while there, interviewed officials of utilities affected by coal conversion orders.

Because ESECA stands to be superseded by an expanded and revised coal conversion program included in President Carter's new energy bill, it was determined that a detailed report on the implementation of ESECA would not be relevant at this time. A "Who Struck John" analysis of ESECA

implementation would be of little value to the Subcommittee in its consideration of the President's program. Thus, this memorandum deals in broad brush strokes with types of problems experienced in ESECA that could crop up again unless care is taken to avoid them. Some of these problems call for tightening of the President's bill by the Congress, while others require imposition of better management procedures on the part of the Administration.

Overview

Some three years after ESECA's enactment, the country has yet to save a single drop of oil or a cubic foot of natural gas by way of an ESECA conversion order. In fact, only one prohibition order has been put into effect. Its upshot: merely to prohibit a utility power plant that already burns coal from burning natural gas that it might otherwise burn this summer on an interruptible, as available, basis. (For specific program procedures and actions taken, see Appendix 1, p. 20).

In terms of practical payoff, the ESECA program has accomplished little or nothing. This is not to say, however, that the program is a total failure. Although the staff feels that FEA took far too much time to develop the program's methodology, that methodology has yielded considerable data underlying coal conversions which should be useful to FEA in implementing the President's program, if and when it becomes law. Although mismanagement was rife in the ESECA program, future program managers can benefit from their predecessors' mistakes, particularly in regard to attainment of unified control of FEA's portion of the program, which has been fragmented in the past. As a result of their own internal review, FEA's current management is moving to correct the shortcomings of the ESECA program management structure. For example,

FEA Administrator John F. O'Leary endorsed the following management principles for the ESECA program in a May 16 memorandum to the program's principal officials:

- The program must have a clearly defined management and decision-making structure.
- Concerned individuals must have every opportunity to present their views on issues of interest to them before the responsible officials make their decisions on the issues.
- Timely program milestones must be established, given high visibility, and followed.
- Subversion of decisions made by responsible officials by continuing the pre-decision debate after a decision has been made, or by ignoring the decision, must be avoided.

In fairness to program officials, it must be said that ESECA was not -- by any stretch of the imagination -- an easy statute to implement. As passed, ESECA was a compromise between proponents of massive coal conversion and advocates of rigid compliance with air quality standards. Consequently, the statute is a hybrid approach to coal conversion. Although ESECA's mandate for coal conversion is clear, there are numerous caveats, including vaguely defined requirements that the conversions be economically practicable and that coal (not specified by the type that a particular boiler needs) be available for conversion candidates within the time frame that they convert to coal burning. Internal wrangling over the meaning of these provisions -- particularly between lawyers and non-lawyers, was inevitable. In view of the statutory deadlines for issuing

conversion orders and enforcing schedules for installation of pollution control equipment, however, prolonged debate over methodology was a luxury FEA could ill afford. "It seems clear that FEA could properly have adopted different, less time-consuming procedures," said an April 22, 1977, evaluation of ESECA by John N. Harmon, Acting Assistant Attorney General, Office of Legal Council. While Harmon considered FEA's approach a legal one, he added that "This is not to say, however, that FEA is precluded from adopting more flexible procedures." After a period of say, one year, FEA should have terminated its internal debate and produced the best methodology possible within the time available. Undoubtedly, some irate conversion order recipient would have challenged the order in court. But that is happening now anyway. Had FEA's methodology been thrown out of court two years ago, the problems of implementation would have been visible to the Congress and Congress could have dealt with those problems. Had Congress not cared to continue with coal conversion, it could have revoked the program and saved the \$4.1 million that has been spent on implementing the program in the past two years. (In all, \$12.6 million will have been spent on ESECA implementation through fiscal 1978). Termination of the program also would have saved utilities and environmental groups a great deal of effort.

Mismanagement

In the staff's opinion, ESECA -- though difficult and confusing -- is a workable statute. Much of the delay in implementing the program has been attributable to the dispersion of management control over the program to a variety of co-equal offices within the FEA.

On paper, the bulk of management authority appears to be vested in the Office of Coal Utilization (OCU), formerly the Office of Fuel Utilization. In reality, however, FEA's Office of General Counsel (OGC) has been a co-equal in management decisions. (Some even argue that the OGC has dominated the program). The OGC performs an independent legal review of all program decisions that have legal ramifications, including the methodology behind prohibition and construction orders, methodologies for performing environmental analyses, and the environmental statements themselves. In addition, still other entities within the FEA have had a piece of the environmental action.

From the beginning, turf battles among these various entities have hobbled the ESECA effort. OCU -- the office most readily identified with success or failure of the program -- has opted for a pragmatic approach to ESECA. By contrast, OGC has demanded a rigorous interpretation of the statute. Proposal after proposal by OCU, including methodologies for various types of conversion orders and for environmental review of the orders, has been rejected by the General Counsel's Office as inadequate. Timetables for issuing prohibition orders slipped and slipped again as the disputes dragged on. In the environmental area, the debate was compounded by the inclusion of two other offices -- the Office of the Assistant Administrator for Conservation and Environment (C&E) and a separate environmental assessment office under the Assistant Administrator for Energy Resources Development -- the official to whom the OCU director reports.

Despite this fragmented management structure, the program slippage could have been avoided had top level management of the agency monitored the disputes and imposed deadlines for their resolution. There is no evidence in any of the files reviewed by the Subcommittee staff that the Administrator or Deputy Administrator -- or even any of their special assistants -- ever umpired one of these disputes during the Ford Administration. Nor is there any evidence that anyone ever asked them to. "Coal conversion simply had a low priority at FEA during the last Administration," said Robert Hanfling, who has served as Deputy Assistant Administrator for Energy Resource Development during both the Ford and Carter Administrations.

Major Disputes

Disputes over interpretation of ESECA have bogged down progress of the program in three major areas:

1. Development of the methodology for determining that coal supply is available to conversion order recipients in the time frame of the conversions;
2. Development of a methodology for the environmental analysis that is required before orders may be issued; and
3. Development of methodology for determining that coal conversions are practicable.

Coal Finding -- Pragmatism reigned in the first phase of the FEA coal conversion program, when prohibition orders covering 74 utility powerplants at 32 sites were issued on June 30, 1975 -- the last day they could be issued under authority provided by the original ESECA Act. The Round 1 coal finding was based on a market survey that matched demand for coal of a certain Btu and sulphur content with the expected uncommitted supply of such coal in a conversion order candidates' geographical region.

Assuming that this coal finding would hold up, Judith M. Liersch, the then director of OCU, announced in an August 5, 1975 memorandum to her branch chiefs that they should be prepared to issue Round 2 prohibition orders by October 1, 1975, providing that Congress extended the order issuing authority by that time. (It was extended on December 22, 1975). Before the Round 2 orders could be issued, however, the OGC found the Round 1 coal finding inadequate and demanded extensive revision prior to OGC sign-off on Round 2 orders. The debate went on for 18 months before the two offices could agree on a revised finding in March 1977. The new methodology required FEA not only to find that uncommitted coal of a given sulphur and Btu content was available on a regional basis, but also to prove that available coal met other characteristics, including moisture, ash, volatility and ash softening temperature. The staff regards the additional characteristics as important ones and thus does not consider the revised finding unreasonable. At best, however, it would appear that a two-month debate over the proposed revision would have been sufficient. Top level

management of the agency should have moved in to break up the impasse -- one way or another -- long before the 18 months it took the combatants to reach agreement on their own.

Environmental Review -- While the debate over adequacy of the coal finding delayed Round 2 utility prohibition orders, internal wrangling on another track was holding up Notices of Effectiveness (NOEs) on the Round 1 orders. This debate centered on the agency's strategy for compliance with environmental requirements of ESECA and the National Environmental Policy Act (NEPA).

OCU's initial environmental strategy was to produce a strong programmatic environmental impact statement for the ESECA program, which would obviate the need for a full-blown environmental impact statement for each conversion order. This strategy was endorsed by Stephen D. Jellinek, Staff Director of the President's Council on Environmental Quality (CEQ), in a February 27, 1975 letter to Judith Liersch.

OCU's strategy began to unravel, however, as soon as the programmatic was drafted. Numerous other offices got into the act, including the Office of Environmental Analysis under Assistant Administrator for Energy Resource Development, William G. Rosenberg (an office detached from OCU in November 1975, only to have some of its functions reassigned to OCU in June 1976), the Office of the Assistant Administrator for Conservation and Environment (C&E), and the Office of General Counsel. Both C&E and OGC criticized OCU's

draft programmatic environmental statement (prepared for OCU and later for Rosenberg's environmental office by an outside contractor) and demanded a hand in its revision as well as in the broader role of shaping overall ESECA environmental policy. C&E sought to impose its own "Guidelines" on ESECA's environmental methodology and OGC demanded that extensive site specific analysis be done with respect to each conversion order. The debate continued from August 1975 to January 1977, when a format embodying the OGC site-specific approach was finally agreed on. At a minimum, Environmental Assessments (EA's) were to be prepared for each site. But where there was a significant potential adverse impact on the environment, full-fledged Environmental Impact Statements (EIS's) were to be prepared.

As the environmental debate dragged on, the Round 1 prohibition orders hung in limbo. No Notice of Effectiveness (NOE) putting conversion into effect by a date certain could be issued prior to completion of a site-specific EA or EIS. As of May 24, 1977, only five Environmental Assessments and no Environmental Impact Statements had been completed, and only one Round 1 NOE out of the 74 electric powerplant units affected by Round 1 prohibition orders had been issued. Among the plants whose conversions were delayed were 22 dual gas- and coal-fired plants consuming about 57 billion cubic feet of gas a year. The 22 units already had a secondary coal burning capability and could have switched to coal on an exclusive basis soon after the conversion orders were made effective.

There were other casualties too. With respect to about half the Round 1 utility prohibition orders, the slip in NOE issuance meant that the date for commencement of coal burning slipped past January 1, 1979, the date on which the Environmental Protection Agency's authority to enforce compliance schedules expires. EPA claimed that unless coal burning was projected to begin before January 1, 1979, the agency had no authority to enforce increments of progress toward meeting air quality standards, e.g., the installation of air pollution control equipment on a timetable that would ensure its readiness by the time coal burning was to commence. "Without enforcement of the scheduled increments of progress, utilities could sit back and do nothing until their prohibition orders become effective in 1979 or later," said K. Gary Moore, a former executive assistant to the OCU director. "When the time for coal burning comes, they could say, 'Oh, we can't burn that coal in compliance with air quality standards.'"

Practicability -- Protracted in-fighting also occurred over development of methodology for satisfying another requirement of ESECA -- that coal conversion be economically practicable.

In the Round 1 orders, conversion was found to meet the practicability test when the utility had the ability to pay for conversions. During the Round 2 planning process, OGC demanded a more rigorous test: that the conversion be put to a plant-by-plant cost-benefit analysis. OCU balked

at this proposal. In a September 23, 1975 memorandum, Stuart M. Rosenbloom, OCU's in-house lawyer, wrote: "There is no indication in the Act that Congress intended to add a cost-benefit test to the other filters against conversion that are explained in great length in ESECA; it is also clear that Congress did not intend that we order conversion only for those candidates that would volunteer to convert because they would make a profit by it."

The crux of the issue was laid down by Jay L. Carlson and Harry M. Yohalem, two FEA Assistant General Counsels, in a December 5, 1975 memorandum to Hanfling and Liersch. The two lawyers argued that a "reasonableness of cost" finding would be necessary in addition to the financial feasibility test contained in the initial prohibition orders. Their reading of FEA's ESECA regulations held that FEA must consider the reasonableness of the additional costs of conversion on a plant-by-plant basis instead of merely considering a utility system's financial capability to absorb the costs of all prohibition orders. The lawyers called for development of a formula that would yield the cost or saving per barrel of oil saved through conversion. If the equation yielded profits, conversions would be deemed "reasonable" by definition. If it yielded a loss, FEA would have to decide at what dollar level a conversion became unreasonable.

OCU and OGC continued to debate the practicability issue until March 1976, when James Rubin, who had succeeded Judy Liersch as director of OCU, accepted OGC's analytical approach but declined to establish a dollar

cutoff level at which conversions are deemed too costly. "The standard of practicability varies from site to site depending upon the age of the plant and other site-specific factors," Rubin said. The staff believes that the uneven treatment of the practicability determination may subject FEA to even greater legal problems than the original Round 1 practicability finding might have encountered.

Other Management Problems

Disputes between co-equal offices were not the only problem that side-tracked ESECA. Both OGC and OCU had their fair share of internal management problems and these problems often were translated into program delays. They included:

- Initial OCU disinterest concerning the issuance of orders for major fuel burning installations (MFBI's), followed by a last-minute rush to get MFBI orders out.
- Disruption in OCU's office routine caused by frequent changes of office directors.
- Open warfare between the director and deputy director of OCU over program methodology.
- Inadequate staffing levels at OGC to support the coal conversion program.

MFBI Effort -- Until recent months, MFBI conversion authority has been an unwanted stepchild of the ESECA program. While authority to issue utility prohibition orders was mandatory under ESECA, authority to issue both MFBI prohibition and construction orders was discretionary with the FEA Administrator. So until well into 1976, FEA placed the MFBI program on a back burner. According to Deputy Assistant Administrator (ERD) Robert Hanfling, his former superior, William Rosenberg, hoped never to have to use the MFBI authority because "he thought industry would come in here and cause a commotion about it."

Working on their own, OCU officials Gary Moore and John Dean developed an MFBI questionnaire in early 1975 and received responses from 822 potential order recipients with 6,289 MFBI combustors. "If somebody had given the word we would have been ready to go with MFBI prohibition orders by late 1975," Dean said. "It was OK to gather data, but we weren't allowed to do much else."

Additional data gathering became necessary when Congress passed the 1975 Energy Supply and Conservation Act (EPCA), which granted FEA discretionary authority to issue orders requiring that MFBI's in "the early planning process" design their boilers to burn coal as their primary energy source. A questionnaire for potential order recipients was drafted in early 1976, but it languished in the General Counsel's Office until

October. After a push by Hanfling in November, the questionnaire went out, and analysis of responses began in early April. On April 12, three days before he was to deliver draft site-specific notices of intention for MFBI prohibition orders, Dean, who had become MFBI division chief in early 1976, was relieved of his responsibility for scheduling and issuing MFBI orders. His superiors charged that Dean had "missed too many deadlines" in the past. Dean, in an interview, acknowledged that some deadlines had been missed but attributed the deadline slippage to lack of support from above. (In the Subcommittee staff's view, Dean's portion of the program was underfunded and understaffed).

Dean's removal in midstream caused unexpected problems. The staff found that in their haste to beat the June 30 deadline, OCU ignored Dean's methodology for construction order issuance, applied no set criteria to its selection of candidates and, in some cases, failed to check on the accuracy of information the companies supplied in the questionnaires.

On May 9, OCU issued notices of intent for 58 MFBI prohibition orders and 56 MFBI construction orders. Dean and other FEA MFBI analysts think the prohibition orders will be legally sound but they fear that the construction orders are defective. The Subcommittee staff believes that the entire MFBI effort, though discretionary, deserved better management support prior to its sudden popularity last November. It believes a

decision should have been made by early 1976 to have all MFBI analysis completed by January 1, 1977, so as to allow adequate time for a smooth transition to order issuance in the event a decision was made to get MFBI orders out prior to expiration of the current order issuing authorities.

Command Changes -- The post of OCU director has become a revolving door - a factor that is particularly detrimental to a program as complex as ESECA. During its three-year duration, OCU has had two directors and three "acting" directors. On July 1, yet another director is scheduled to take over. The directors who have served thus far provide a contrast in philosophies and management styles. According to OCU staffers, the lack of continuity has lowered office morale and impaired performance.

Another problem has surfaced with the latest management change, in which James Rubin was replaced in April by John Schuler, who was to serve as "interim" director. Gary Moore -- a talented Rubin assistant who had been with the program since its inception -- was removed from the management process following Rubin's departure. Moore -- who could have provided continuity between Rubin and Schuler -- went for weeks without any work assignments. Finally, he took it upon himself to organize a task force of similarly displaced staffers to prepare Round 1 Notices of Effectiveness so that the NOEs will be ready for issuance when environmental analyses are completed. Officially, the office's total effort is being aimed at issuance of prohibition and construction orders that have to be out by the June 30 deadline.

Rubin-Parker Feud -- Another factor that has hurt morale at OCU has been a long-standing conflict between Rubin and his deputy, Gerald J. Parker, over program methodology.

The dispute came to a head last February 9, when Parker, in a memorandum to Rubin, accused Rubin of "gilding the lily" in his technical analyses and his toleration for OGC's legal approaches. Parker, arguing for simplicity and pragmatism, said his purpose was to put pressure on Rubin and other "obstructionists" to adopt a level of effort that would give OCU an "outside chance" of meeting the June 30 deadline. While the Subcommittee staff thinks there is a basis for Parker's criticisms of program methodology and performance, it also believes that the situation had been vastly improved by the time Parker sent his memo to Rubin. At the time the memo was written, the OGC ESECA legal staff had been re-constituted, coal conversion was getting greater OGC priority and relationships between OCU and OGC had taken a quantum jump for the better.

The results of Parker's February 9 memo are a mixed bag. On one hand, they heightened tensions in what was an already overwrought office. But on the other, they brought needed public and Congressional attention to bear on the deficiencies of the ESECA program.

OGC Staffing -- Prior to December 1976, when ESECA was given a higher OGC priority, inadequate OGC staffing levels were a roadblock for the ESECA program. Until last December, only two OGC attorneys were assigned to the program, and one of them had additional duties pertaining to legislation and general law. Since December, four OGC attorneys have been assigned full-time to the ESECA program and there is an authorization to hire two more.

EPA Role

At the time of ESECA's passage, proponents of coal conversion feared that EPA would seek to block conversions while FEA would try to expedite them. In practice, EPA has been basically cooperative, and FEA has been the stumbling block (though the cause has been ineffective management rather than subversion of the program).

EPA's role in ESECA is to certify to FEA the earliest date that plants or installations receiving conversion orders can comply with air quality requirements. With some exceptions, EPA can issue compliance date extensions to enable conversion candidates to burn noncomplying coal provided the plant will be in compliance by January 1, 1979.

Although it gets generally good marks now, EPA was not always so cooperative. In fact, had FEA acted in a timely fashion to discharge its duties, EPA would have caused some delays during the second year of the program. In 1975 and 1976, it appeared that EPA was lagging in certifying

compliance dates for Round 1 utility prohibition order recipients. Many of the certifications came in mid- to late 1976 -- a year after FEA issued the Round 1 prohibition orders. By April 22, 1977, EPA had issued 63 of the 74 certifications required for Round 1 orders. The stumbling block to issuing notices of effectiveness was not EPA but FEA, which had not yet completed its environmental work on the orders.

According to both FEA and EPA sources, EPA was amenable to signing a joint policy statement with FEA that, among other things, would have committed EPA to encouraging utilities now burning non-conforming oil or gas. On March 30, 1977, a draft policy statement reflecting suggested FEA changes was sent from EPA to FEA, but FEA still had taken no action to finalize the agreement by May 25, 1977.

Conclusion

Although ESECA is a complex statute, there is little if any excuse for FEA's failure to implement it in a more timely fashion. As the Justice Department's assessment of the program indicated, FEA could have opted for a more flexible approach to implementation. Instead it chose a tortuous one.

Nonetheless, if a coal conversion program is to continue, a simpler statute would be beneficial. Efforts should be made to avoid phraseology that could be subjected to conflicting interpretations by FEA.

The President's coal conversion proposals, included in his energy bill, are a good start. They certainly are more workable than ESECA. The new methodology of the President's bill would supersede the ESECA methodology in plants now under ESECA orders or notices of intent to issue orders. That methodology holds as follows: the burden of proof with regard to coal availability would be shifted to industry; however, FEA would retain the burden of proving the practicability (redefined as "financial feasibility") of conversions. If coal conversion is deemed a national priority -- as it should be -- the entire burden of proof should be shifted to industry.

No matter what the statute looks like, however, it is hoped that the Subcommittee will encourage FEA's top management to follow through on its commitment to give coal conversion more management attention. Many of the problems that beset ESECA in the past have now been ironed out, but others remain, and the old ones -- such as the OGC-OCU animosity -- could surface again as soon as the present cast of characters changes or individuals' views change. Program structure is fundamentally sound; however, inter-office disputes must be arbitrated by the Administrator's office and, where appropriate, deadlines for decisions must be imposed from above. To ensure that management improvements are carried out, it is recommended that the Subcommittee staff monitor the program periodically and conduct another full-fledged oversight review six months from now -- or earlier, if circumstances warrant.

APPENDIX I

ESECA -- Procedures and Performance

ESECA requires FEA to prohibit an electric power plant from burning petroleum and natural gas when the agency finds that: (1) the power plant had the capability and necessary plant and equipment to burn coal on June 22, 1974, or acquired it after that date; (2) conversion is practicable and consistent with the purposes of ESECA; (3) coal and coal transportation facilities will be available during the period when the order is in effect; and (4) the order will not impair the reliability of electric service in and areas served by the plant

Other ESECA authorities provide FEA discretionary authority to: (1) prohibit major industrial generating units ("Major fuel burning installations") from burning oil or gas as their primary energy source, subject to the same criteria affecting power plant conversion (above) except for the system reliability finding, and (2) require certain power plants and installations in their "early planning process" to be designed and constructed with the capability to burn coal as their primary energy source.

The Environmental Protection Agency's role in the ESECA program is to certify the earliest date by which plants under ESECA conversion orders can burn coal in compliance with air quality standards, and subject to certain rules, to issue compliance date extensions.

There are three steps in the coal conversion process under ESECA. FEA's first move is to publish in the Federal Register a "Notice of Intent" (NOI), indicating that the agency plans to issue a prohibition order. The NOI gives the potential order recipient a chance to make a written or

oral response to the FEA findings. After considering the response, FEA decided whether or not to issue a prohibition order, and then issues the order, if appropriate. After performing site-specific environmental analyses and obtaining EPA certifications, the order, if still appropriate, is finally put into effect by a Notice of Effectiveness (NOE) that sets a date certain for the commencement of coal burning.

As of the date of this report, May 24, 1977, FEA has taken the following actions under ESECA:

<u>UTILITY</u>	<u>SITES</u>	<u>UNITS</u>	<u>SAVINGS OIL</u>	<u>PER YEAR GAS</u>	<u>EQUIVALENT COAL DEMAND</u>
Prohibition Orders or NOIs	50	105	85 million bbls.	59 billion cub. ft./yr.	25 million tons
Construction Orders	97	143	810 million bbls.	0	221 million tons
MFBI					
Prohibition Order NOIs	24	58	12 million bbls.	23 billion cub. ft./yr.	4 million tons
Construction Order NOIs	32	56	20 million bbls.	0	5.2 million tons

As of May 25, a limited number of NOEs had been issued. Only one NOE had been issued with respect to utility power plant prohibition orders. NOEs affecting 30 units at 21 sites had been issued with respect to utility construction orders. No NOEs had been issued with respect to MFBI construction or prohibition orders.

STATEMENT OF THE AD HOC COMMITTEE FOR A FAIR NATURAL GAS POLICY

Mr. Chairman and members of the Subcommittee, my name is R. Timothy Columbus and I am here today on behalf of the Ad Hoc Committee for A Fair Natural Gas Policy. The Ad Hoc Committee deeply appreciates this opportunity to share with you its concern over certain aspects of the proposed legislation presently under consideration by the Subcommittee.

The proposed amendments to the Energy Supply and Environmental Coordination Act of 1974 presently under consideration reflect, as do other portions of this legislation, an attempt to provide the government with the tools necessary to achieve a goal, with which my client's members, all of whom are participants in the fuel oil business agree, i.e., to reduce this Nation's unnecessary consumption of imported petroleum. However, my client believes that as presently drafted, this proposed legislation ignores and, if enacted, may aggravate a problem of potentially greater urgency, specifically increased and non-essential consumption of natural gas.

It is my client's understanding that domestic reserves of natural gas are being depleted at a rate which exceeds the rate of depletion to which domestic reserves of crude petroleum are subject. Given the Nation's experience during the past winter, in which hundreds of thousands of individuals' employment was interrupted as a result of inadequate supplies of natural gas for process fuel and other essential users of natural gas, my client believes that this Subcommittee should amend this portion of the bill to the extent necessary to minimize immediately the unconscionable consumption of natural gas as a boiler fuel by consumers which have the present capacity to employ an alternate fuel.

Mr. Chairman, as you and other members of the Subcommittee are aware, the availability of adequate supplies of natural gas is a condition precedent to many

industrial activities. One cannot manufacture stainless steel, produce some glass, print a newspaper, or dry paint on automobiles without natural gas. Therefore, to the extent that increased supplies of this resource can be made available by limiting a class of consumers' use of natural gas without the imposition of burdensome capital costs on that class, it seems only reasonable that such action be taken, and Mr. Chairman such a class of natural gas consumers does exist.

Throughout portions of the mid-continent, consumers with dual capacity, have been consuming quantities of natural gas substantially in excess of their rate of consumption during the three year period preceding the 1975-1976 heating season. This increased consumption has coincided with severe curtailments of and interruptions in natural gas supplies to other parts of the country. While some of these consumers fall within the definition of "major fuel-burning installations" contained in the bill, most do not. In light of this fact, my client recommends that this Subcommittee require natural gas consumers, which possess the current physical capability to employ alternate fuels for non-essential uses to terminate their consumption of natural gas. At a minimum, my client urges this Subcommittee to expand the scope of these amendments to include substantial consumers which are not included in the bill's present definition of "major fuel-burning installations" and to provide the Administrator with the authority to order the conversion of such consumers from natural gas to alternate fuels. Such action by the Subcommittee would serve as a major step towards preventing the type of hardship which the country endured last winter without imposing burdensome capital costs upon any consumer.

The above described expansion of natural gas service to the boiler fuel market in some areas has resulted in other undesirable effects. As you are aware,

Mr. Chairman, the boiler fuel most frequently replaced by natural gas is residual fuel oil, a product which is the inevitable result of crude oil distillation. To the extent that increased natural gas service reduces the market for residual fuel oil, the production of other, lighter products is restricted which results in supply dislocations in those products.

Many areas are currently inundated with residual fuel oil. This phenomenon is forcing some refiners to reduce their crude oil runs to stills and thus to reduce their production of lighter products during a peak period of demand.

The fundamental question which my client believes the Subcommittee must address in this area is, should the nation attempt to reduce its petroleum consumption by prematurely exhausting its very limited reserves of natural gas through their unnecessary consumption as a boiler fuel.

In light of the terrific dependence of many industries, and therefore many employees, upon the availability of natural gas, my client believes the answer to this question must be in the negative.

Once our gas reserves are depleted, the cost of their replacement is very high, i.e. either imported liquified natural gas, synthetic gas produced from petroleum, or synthetic gas produced from coal. If either of the first two alternatives is chosen, our dependence upon foreign energy sources will increase both in absolute terms and duration. At present the technology required for economic exploitation of the third alternative does not exist. If essential users, whose demand is inelastic, are compelled to consume these high priced alternatives, one must believe that serious economic consequences will result.

My client believes that logic dictates immediate action to protect the nation's rapidly depleting reserves of natural gas for essential users if the nation is to avoid a future dependence upon foreign sources of natural gas similar to that to which we have subjected ourselves in petroleum. In light of Alaskan production's coming on stream in the near future and current and foreseeable supply conditions, adequate supplies of residual fuel oil and will be available to sustain boiler fuel demand during an orderly and economically sound program of converting our energy base to coal.

Too many times, particularly with regard to energy policy, we have addressed ourselves only to that which appears most undesirable at the time and thereby have created subsequent problems of a magnitude equal to or greater than the problem we originally sought to solve. Mr. Chairman, my client is confident that you and the other members of the Subcommittee will not let this happen again.

On behalf of the Ad Hoc Committee, I again thank the Chairman and the Subcommittee for this opportunity and will gladly respond to any questions which my testimony may have raised.

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COMMENTS
of
AMERICAN PETROLEUM INSTITUTE
on
Part F. of H.R. 6381, "National Energy Act"

The American Petroleum Institute has been following the development of a national coal conversion program as set forth in S. 977 and earlier legislation proposals in the Senate, and as further defined in Part F, Revision of the Coal Conversion Program, of H.R. 6381. Because of the importance of this proposed legislation and its impact on steam boilers and process heaters used in petroleum refining, we wish to submit the following comments.

The American Petroleum Institute is vitally concerned with increasing the self-sufficiency of energy supplies in the United States. Any national energy program should provide for development and prudent use of domestic energy resources. Such a program must include continued diligent efforts to conserve energy and foster development of domestic energy resources, especially our abundant coal reserves. To achieve a reasonable degree of self-sufficiency, government and the private sector must work cooperatively, constructively, and expeditiously over a sustained period of time. We believe strongly that the competitive marketplace is the best means of encouraging efficient use of coal as an energy source. However, if the Congress deems it necessary to pursue the legislative route, we would like to share with you some of our concerns about the effect of proposed legislation on refining installations.

We endorse the concept of maximizing the use of coal where such use is technically, environmentally and economically feasible. Nevertheless, we consider temporary exceptions for mandatory coal use to be

essential, for several reasons. One reason is the problem that may arise in obtaining and transporting the required supply of coal to the fuel-burning site. A second reason is to allow for, and encourage, advances in technology and engineering developments that will, in time, enable coal to be used for process heat.

The exceptions already contained in H.R. 6381 properly recognize the need for the Administrator of the program to consider the cost-effectiveness of coal conversion and the economic waste involved in retiring existing useful equipment prematurely. We suggest that the exceptions take into account the possible non-availability of coal supplies and the lack of adequate transportation facilities in many instances. And we suggest that the exceptions take into account the cost relationship between coal and other competing sources of energy.

Recognition, in H.R. 6381, of these factors would, in our judgment, reduce the need for many coal-conversion decisions to be made by the Administrator. Such recognition would also lighten the heavy reporting burden on both the government and industry, by reducing the number of requests that are likely to be made for exceptions to the provisions of the present bill.

In our judgment, over-reliance on the regulatory approach, rather than the market value of fuels, will result in delays in achieving the objectives of H.R. 6381. These delays will result from conflicting interpretations of the regulations by the Administrator and the regulated industries.

In Section 102, Par. (4), permission to use the heating value of waste gases and other gaseous, liquid and solid byproducts as heat sources will stretch energy resources and conserve crude oil.

In Section 102, Par. (6)(A) and Par. (7)(A), we suggest changing "...one hundred million British thermal units per hour or greater..." to read, "...two hundred and fifty million British thermal units per hour or greater...."

In Section 102, Par. (6)(B) and Par. (7)(B), we suggest changing "...two hundred and fifty million British thermal units per hour or greater..." to read, "...five hundred million British thermal units per hour or greater..."

These suggestions are based on our concern that the indicated combustor lower heat limits will create an inordinate manpower burden on both industry and government and result in delays because of the administrative complexities of developing and obtaining agreement on the basis for exception and exemptions, as well as interpretation of the law. Many refinery steam boilers are of the relatively small size of 100,000,000 Btu per hour heat rate or less. These smaller boilers typically are not convertible to coal-firing. A boiler size of 250,000,000 Btu per hour heat rate and above would be a more likely candidate for coal conversion with current technology. Increasing the minimum combustor size would reduce the number of combustors which must be considered by the Administrator, and also focus on those installations that, by their size, will be most cost-effective in terms of coal conversion and have the most significant impact on replacing oil and gas with coal.

Section 102, Par. (12), of H.R. 6381 appears to make the assumption that it is readily possible to convert boilers and other equipment to coal use, and that such conversion would be in full compliance with environmental requirements of the Clean Air Act. Petroleum engineers do not believe this assumption is correct, even if the best available technology is employed and even if low-sulfur Western coal is used. This

would be especially so in the major metropolitan areas of the U.S., where 70 percent of petroleum refining capacity is located.

We therefore believe that significant conflicts will arise between the objectives of H.R. 6381 and the objectives of current and contemplated environmental legislation. To resolve these conflicts in favor of H.R. 6381's objectives might require substantial changes in existing or proposed environmental legislation and programs.

In Section 106 (a)(2) and (3), we find the language and the concept of "categories" of combustors to be an improvement over previous proposals.

The petroleum refinery's main task is not to boil water to make steam, but to heat and boil hydrocarbons to make petroleum products. Furnaces and heaters that are used to process crude oil and other products do not - and cannot - now use coal as a heat source.

If use of coal to heat petroleum were mandated for refineries today, furnace tubes would likely coke up or plug if the heat flux were uneven or too high. Coking and plugging can cause catastrophic failure of a tube and possible explosion and fire. Also, the fast and accurate temperature control necessary in many refinery processes is at present impossible to achieve with coal firing.

Combustor manufacturers are doing research to develop coal technology for such process applications, but in our judgment, demonstrated commercial feasibility is several years away. Such research should be expanded to include demonstration projects of commercial size. Also, the Energy Research and Development Administration (ERDA) is sponsoring research programs to develop fluidized-bed coal-firing technology. This technique

offers potential advantages over conventional coal burning in the area of capital investments, operating costs, and environmental control. But even if successfully developed, the technique will not be commercially available for a number of years.

There are other factors to be considered in addition to the technical problems of coal firing. The most important factor is the location of combustors in most refineries, which would make coal conversion difficult, expensive and, in some cases, impossible.

It is important to note that most refineries consist of many close-quartered and complex operating units. Each unit contains numerous pieces of equipment. The process furnaces and other combustors are generally located very near the equipment they service. These combustors and other heaters cover a broad range of heat outputs, and each one is tailor-made for its particular job. In many instances, space is simply not available within the refinery for new combustors or to install facilities to store and prepare coal. In addition, the distribution of solid fuel to, and the handling of ashes at, the many scattered sites would be a mountainous problem.

Appendix I to these comments is a copy of the presentation made by the American Petroleum Institute on April 7, 1977, to the Office of Coal Utilization of the Federal Energy Administration. The presentation goes into some detail about the limitations of refinery process heaters and furnaces for conversion to coal.

As stated earlier, we believe coal will be cost effective for many applications in a free market environment. We compliment the sponsors of H.R. 6381 for specifying that the economics of coal conversion are to be considered in exceptions and exemptions. The interrelationships of

economics with environmental, technological, and safety factors must also be considered. We submit that certain industrial processes are better served by fuel other than coal for reasons of process control, product quality, and safety considerations. Thus, we recommend that these factors be included in the decision on exceptions and exemptions.

One resource that needs to be given greater consideration as an alternate to coal is residual fuel oil. Residual oil is what is left over after the lighter products are made. It is not readily converted into lighter products. Currently, yields of residual oil from U.S. refineries average about 10 percent of the crude oil processed. It represents an attractive substitute for natural gas as a burner fuel both for petroleum refiners and industrial users. We view the use of residual fuel as an acceptable alternative to coal where space, coal supply and other conversion problems make coal unacceptable and unavailable.

In summary, the API supports the nation's efforts for the use of coal instead of natural gas and petroleum by electric power plants and industrial installations. However, we urge consideration of ways to reduce the complexity and administrative burden of the provisions of this Act by more reliance on market forces to set priorities and fuel choices, and by limiting the scope of its applicability in the initial years, as experience and technology are built up.

APPENDIX I

AMERICAN PETROLEUM INSTITUTE
COMMENTS TO FEDERAL ENERGY ADMINISTRATION
OFFICE OF COAL UTILIZATION

The American Petroleum Institute wishes to submit several recommendations regarding energy conservation and domestic energy supply development, two of the most important elements of a sound energy policy. It is clearly vital to the economic health and security of this country that immediate action be taken to accelerate domestic energy production and to increase energy conservation. To arrest and reverse the increasing dependence on foreign sources for this country's energy needs will require the best efforts, over a sustained period of time, of government and the private sector working cooperatively, constructively and with deliberate speed toward the goal of a reasonable degree of energy self-reliance. The API believes that the role of the government should be to provide workable and practical policy guidelines for accomplishment of domestic resource conservation and development. Private industry's role should be the timely development of U.S. energy resources, within the policy guidelines, operating in a free market environment with price as the incentive for supply and the restraint on demand. Together, government and private industry must speak out and work for sound national energy policies and provide the leadership and education in the energy conservation and energy development effort.

Our society, which has become accustomed to exponential growth in consumption of energy from natural gas and petroleum, has difficulty in coming to terms with the finite nature of these valuable resources. We

must therefore redouble our efforts to educate the public, government and industry to conserve these two resources for higher-value uses and begin to utilize more abundant, domestically secure energy sources. Over the next 10-15 years we must count heavily upon coal as the primary domestic source to augment declining domestic supplies of natural gas and oil. The API supports the basic objective of increased coal utilization which will result both in the conservation of domestic natural gas and petroleum supplies and a reduction of imported petroleum products. Currently, there are efforts within industry and the government to foster the increased use of coal to conserve the dwindling domestic reserves of oil and natural gas. Under current rules and regulations, as defined in ESECA of 1974 and EPCA of 1975, the FEA is authorized to require the utilization of coal as a primary fuel in certain utility and major fuel burning installations (MFBI). As a mechanism to accomplish this, the FEA has recently initiated the MFBI Early Planning Process Identification Reports. These reports, along with previous identification reports, recognize that the utilization of coal in certain industrial combustors requires consideration of the interrelationships of economic, environmental, safety and technological factors. We believe in the need to promote greater use of indigenous coal resources and believe generally that coal utilization will be cost effective in a free market environment, but we do not favor the principle of greater use at any cost. Mandatory utilization of coal must be evaluated on an individual combustor basis considering all of the above factors. Care must be taken to avoid forced conversion to coal in certain industrial processes which, because of safety, process control, and product quality considerations, are best served by noncoal fossil fuels. Careful evaluation of technological

factors is a key requirement in considering use of coal in certain categories of combustors. An API task force of combustor users and combustor manufacturers has reviewed existing technology for the direct burning of coal in combustors, other than boilers, used in refining. This task force, in considering the application of coal-firing technology to existing process heater design concepts, chose to categorize combustor designs by severity of process service. As discussed below, coal-firing is not feasible in certain applications but with the development of technology appears feasible in others. The task force has defined three basic categories of combustors, with stated coal-firing limitations, as follows:

1. Designs of heaters for high temperature process reactions or high pressures and elevated temperatures:
 - (a) Require that metal pressure parts be at temperatures approaching the coal ash fusion point, implying severe corrosion problems;
 - (b) Have metal pressure parts operating near the safe high temperature strength limit and require precise control of the heat flux to avoid overheating of these parts; and
 - (c) Commonly require many small burners in order to adequately control heat flux distribution.

Limited experience is available to identify the magnitude of the corrosion problem. However, studies of the effects of the (much milder) corrosive agents in oil fuels have led to the conclusion that sulfur and many metal salts, common to coal ash, will rapidly destroy the highly alloyed materials used in high temperature and/or pressure heaters. Also, detailed knowledge of heat transfer from coal flames, as required to design for and control precise heat flux distributions in refining process combustors is presently lacking. Therefore, we conclude that it is presently, and for

the foreseeable future, impractical to design for coal firing in heaters designed for high temperature process reactions or for high pressures and elevated temperatures.

Heaters falling in the above class include those for ethylene pyrolysis, steam-hydrocarbon reforming, hydrocracking, and some hydrotreating. They are to be found predominantly in the chemical, petroleum, and fertilizer industries.

2. Designs that process fluids subject to thermal decomposition require close control of the temperature of the fluid adjacent to the heat absorbing surface (known as the fluid film). Overheating of the fluid film will lead to formation of decomposition products and plugging and/or overheating of the tubes. Relatively close prediction and control of heat flux is required in order to obtain satisfactory run length and operational safety. Also, it is necessary to provide for rapid extinction of combustion for the case when thermal decomposition is detected. These factors will likely remove stoker-fired designs from consideration for these services. Since adequate knowledge of heat flux prediction and control is lacking, the application of coal firing to this class of units is presently unfeasible and should be deferred until coal-firing is developed and proven for less severe services. Services susceptible to thermal decomposition include heaters in cokers, visbreakers, thermal crackers, and vacuum flashers in the petroleum refining industry.
3. Designs for general process service are not available for installation today, but are considered as first priority candidates for development of coal-firing designs. Current and traditional designs do not satisfy the fundamental technical requirements for burning coal. In addition,

we expect that larger combustion chambers and fewer burners of greater heat release, as compared to current designs, will be required for firing pulverized coal. Vertical upward firing, as currently applied with gas or oil fuels, to give the most even heat distribution in economically-sized fireboxes will not be possible with coal fuel. Maintenance requirements on combustor, fuel, and ash systems may limit heater availability. Experience with coal-fired boilers indicates that stream factors are less than currently considered desirable in process applications.

Existing coal-fired boiler technology and features are deemed directly transferrable to process heater design in the areas of coal handling, ash or slag handling, flue gas conditioning, and maintenance facilities. Improvement of pulverized coal firing control is possibly indicated. Problem areas requiring solution before general application of coal firing to process heaters can be attempted are:

- (a) Obtain detailed knowledge of coal flame characteristics and heat transfer from coal flames.
- (b) Solve problems of slagging, fouling, and corrosion of high temperature pressure parts and refractory.
- (c) Develop techniques for controlling heat flux distribution with coal firing. This includes consideration of fuel distribution, air distribution, and small burner development.

A review of the foregoing indicates that one is unlikely to find any existing process heaters that would be suitable for retrofitting for coal burning. Also, the auxiliary equipment (air preheater, ash collection and handling facilities, fuel facilities) requires much more plot space than is available in most plants. Therefore, we judge that no existing heaters

are candidates for modification to burn coal.

Also, we judge that no existing fired heater designs readily lend themselves to revision for coal firing. Since the heater design is a marriage of process side and combustor designs this means that new designs for coal firing will probably have to include additional modifications to handle process considerations. Thus, the design uncertainties will be magnified and care in selecting initial applications is recommended.

While technical feasibility is a primary consideration in the nation's coal-conversion strategy, it is not the only one. Guidelines concerning cost effectiveness, environmental conservation, safety, coal availability, logistics and other important factors must also be provided. A mechanism to assure cost effectiveness should be established. The most straight-forward approach would be to establish a priority order based on combustor size. Use of coal in the largest installations will, in general, be the most cost-effective use of available resources while at the same time making the most substantial impact upon conservation of oil and natural gas. Mandating coal-firing for combustors which are not cost effective, which is more likely to be the case in small installations at the threshold MFBI level of 100MM BTU/hour, will create an undue burden on human and capital resources, will be destructive to the small fuel user, and will inhibit real growth of the economy.

If implementation of coal conversion is to be timely, we believe that current environmental regulations, initiatives, and legislative proposals must be reexamined for consistency with the current MFBI regulations. This may require restructuring of existing programs and proposals. Development of coal supplies may involve environmental/energy tradeoffs to assure that coal conversion is implemented in a timely manner.

A coordinated government/industry effort is essential to assure that coal supply and logistics will be coordinated with industry's conversion to coal. Such an effort would necessitate that planning efforts to address minemouth-to-user transportation are consistent with the coal conversion timetable. Current debate between government, rail, barge and pipeline interests must be brought to a successful conclusion quickly if potential coal suppliers and identified coal users are to proceed with coal-conversion implementation.

In summary, the American Petroleum Institute believes that substantial progress can be made in reducing our dependence on foreign energy supplies through development of sound conservation practices and the dedication of human and material resources to the development of indigenous energy supplies. This can best be achieved through cooperative government/industry efforts. The government can and should provide leadership and policy guidelines for accomplishment of conservation and domestic resource development objectives. The private sector, and specifically industry, should have the responsibility, working within the policy guidelines, to achieve the conservation goals and develop the energy resources while operating in a free market environment with price as the incentive for supply and the restraint on demand.

June 6, 1977

STATEMENT BY THE COMPANIES OF
THE NORTHEAST UTILITIES SYSTEM
ON THE COAL CONVERSION PROVISIONS OF
THE PROPOSED NATIONAL ENERGY ACT

The companies of the Northeast Utilities system endorse the recently articulated national policy of reducing our country's dependence on oil and gas and increasing its reliance--insofar as electricity is concerned--upon coal and nuclear energy. We believe that we have already gone a long way toward accomplishing this national objective. Because New England was and still is at the end of the fossil fuel "pipeline", we embarked, in the early 1960's, upon a course of providing base-load capacity from nuclear power plants. We believed, and time has proven, that this nuclear expansion program would be cost-effective and environmentally sound.

This program has also accomplished our objective of reducing our dependence on imported residual oil. The total nuclear capability of our system as of May 1, 1977 was 1,958 megawatts (MW), or approximately 30% of the system's total net capability. In the crucial 1970's we reduced our dependence on residual oil to such an extent that in 1976 the Northeast Utilities system used only 50% of the oil it needed in 1973, in spite of the growth in energy consumption which had occurred during that time. From January 1974 nuclear generation has

saved the NU system more than \$300 million and over 50 million barrels of oil. In the month of April 1977 we supplied about 70% of our total energy requirements from nuclear power. Oil savings were approximately 8.1 million barrels in the first four months of 1977 and approximately 21.6 million barrels in the 12 months ended April 30, 1977.

Millstone Unit 3, an 1150 MW nuclear plant which is under construction and scheduled for completion in May 1982, will save approximately 12 million barrels of oil per year. Moreover, we intend to build twin 1150 MW nuclear units at Montague, Massachusetts which are scheduled for completion in 1986 and 1988 and which together should reduce dependence upon oil by about 24 million barrels per year. After these units become available, nuclear power will reduce our system's dependence on oil by almost 50 million barrels per year.

Financing a nuclear base-load expansion program which is highly capital intensive has continuously strained our ability to raise the necessary capital. However, the end result has been a modern, reliable electric supply system with a favorable generation mix, which has resulted in rates that are increasingly competitive with those in other parts of the country that have traditionally benefited from proximity to coal, oil and gas.

Now, however, we are faced with six proposed Prohibition Orders from the FEA under the Energy Supply and Environmental Coordination Act of 1974 ("ESECA"). These orders would require conversion to coal burning of The Connecticut Light and Power Company's two units at Norwalk Harbor, Connecticut, three units of The Hartford Electric Light Company at Middletown, Connecticut and Holyoke Water Power Company's Mt. Tom unit at Holyoke, Massachusetts. These six units, built between 1954 and 1964, aggregate 900 MW or about 13% of the NU system's generating capacity. We are presently engaged in proceedings before the FEA and the courts in which we are contesting these proposed orders because they will have a number of significant adverse effects on our customers, our investors, our companies and the public at large. We have presented extensive testimony before the FEA on those proposed orders. Some highlights of it are as follows:

1. Conversion of these units would require capital expenditures of \$277 million (or \$306 million if flue gas desulfurization equipment is required at the Mt. Tom station to meet air quality requirements). These expenditures would not increase the capability of our system to serve the growing energy requirements of our customers in the 1980's; in fact, coal conversion would reduce the peak generating capability of these units by 73 MW or about 8%.

2. In view of our present weakened financial condition, we already need substantial rate relief in order to finance our present construction programs. Because of the presently negative rate-regulatory climate in which we are operating, we have already found it necessary to reduce the construction programs of our Connecticut companies to levels below those which we believe to be the minimum required by good utility engineering practice. If the capital costs needed to convert these six units to coal are allowed to create an additional pressure upon the financing needs of our companies, our present construction programs will suffer, and we will probably be required to delay completion of Millstone Unit 3 and the two Montague units. Rate relief which would be sufficient to enable us to meet coal conversion costs as well as to satisfy the demands of our present construction programs does not appear to be available in the present regulatory climate.

3. The customers of the Northeast Utilities system would have to pay between \$2 billion and \$2.5 billion more by the year 2000 to support a program of coal conversion for these six existing units if coal conversion results in those three nuclear units being delayed by two years each. Even if sufficient financing were available so that coal conversion

did not affect our nuclear construction program, our customers would have to pay between \$840 million and \$1,250 million more by the year 2000.

4. A delay of two years in completion of the three nuclear units previously mentioned can be expected to increase the use of oil in New England by 72 million barrels during the period 1982 through 1990. This increase would largely offset the oil which conversion to coal of our six units would replace so that there would be no significant net oil savings from this FEA action.

5. Conversion of these units would reduce the reliability of electric service in New England below the minimum reliability criterion adopted by the New England Power Pool in several years during the 1980s. Delays in completion of our three nuclear units would worsen this situation. In addition, we envisage electricity supply problems in the Southwest Connecticut area during the conversion period if our Norwalk Harbor units and the three Bridgeport Harbor units of the United Illuminating Company are required to switch to coal as their fuel.

6. Conversion of six units to coal burning would have significant environmental impacts. Emissions of particulates and nitrogen oxides into the air would be increased. Enormous quantities of ash and sludge from flue gas desulfurization equipment would be produced. For the five Connecticut units the volume of this solid waste could be about 620,000 tons per year, enough to cover each year about 378 acres of land a foot deep. These wastes would aggravate Connecticut's already serious solid waste disposal problems. We are not aware of any disposal site for such wastes in Connecticut that would be acceptable to the state environmental authorities.

Serious as these consequences of the FEA's proposed Prohibition Orders under existing law would be, the proposed National Energy Act, House of Representatives Bill 6831, would amend ESECA in ways that would magnify these adverse effects in scope and impact. This Bill would increase our system's exposure to additional conversion orders. Up to 12 other units could conceivably be subjected to conversion orders, which would require the raising and expenditure of enormously larger amounts of capital, in the order of approximately \$950 million more. It could make futile our efforts to show that the six pending orders should not be implemented by reducing the procedural

and substantive requirements of the present law and empowering the FEA Administrator to shortcut the six present proceedings.

The resulting burdens and sacrifices should not be imposed on our customers and investors and the economies of our states. Our customers have already financed the high capital costs of our nuclear expansion program, and they have just begun to reap its benefits. To require them now to bear additional costs, whether under the National Energy Act or ESECA, would fail to recognize that we have already taken significant steps to meet the national objective of reducing the country's dependence on oil by implementing our nuclear expansion program.

Our concerns with the coal conversion provisions of the proposed National Energy Act center largely on proposed new Section 105 of The Energy Supply and Environmental Coordination Act of 1974 and related provisions which deal with the conversion of existing electric powerplants. However, although our present problems involve existing plants and we have no plans to install new fossil-fuel-fired plants, our analysis of the exemption provisions for new plants in proposed new Section 104(b) does indicate that these provisions are so structured as to be impossible to meet, except possibly for the exemption

in Section 104(b)(3) for peaking plants, which run less than 1500 hours per year. Even that exemption for peaking plants requires much more definition and needs to take account of the fact that in New England peakload generating units may have to run much longer than 1500 hours a year in order to meet customer needs.

The provisions for existing plants in new Section 105 will provide, in our opinion, significantly less protection for the interests of utility consumers and investors than the present ESECA provisions. This is so, first, because of the new Section 105(a)(2)(A), which would permit the Administrator to issue by rule blanket prohibitions against natural gas or oil burning, without having to satisfy even the present minimal procedural requirements of ESECA. No provision is made for an EPA environmental review. The classes of plants to which such a rule could apply are apparently to be determined entirely by the Administrator's discretion. No statutory criteria are specified, except that the Section provides that one class of prohibited plants may be those for which prohibition proceedings are currently pending under ESECA. Because of this lack of statutory criteria, the Administrator would apparently be entitled to prohibit oil burning by plants, such as gas turbine peaking units, which are incapable of burning coal.

The apparent impact of this new Section 105(a) (2) (A) on utilities such as the Northeast Utilities System which have pending ESECA prohibition proceedings is particularly disturbing. We have devoted to date over 20,000 hours of employees' and consultants' time to our pending ESECA proceedings. All of this effort and the accompanying costs could be wasted if new Section 105(a) (2) (A) were enacted and the Administrator then moved to shortcut the pending proceedings by adopting a rule which would cover our plants. A mid-stream change in approach such as this seems grossly unfair to us.

The Bill would retain in new Section 105(a) (2) (B) and (C) the present procedure on issuance of prohibition orders for additional plants, but with a significant cutback in the scope of the preliminary findings that would have to be made by the Administrator. Thus, the present requirement of ESECA that a plant have in place "necessary plant equipment" to permit coal burning would be eliminated. Further, the Bill would replace the present requirement of a finding of "practicability", under which the Administrator has had to consider the comparative economics of the plant in burning oil or coal, with a new requirement that the Administrator find only that "the use of coal is financially feasible". Section 105(a) (2) (C) (ii). While the concept of "financially feasible" is not defined in the Bill, it clearly does not require a consideration of comparative economics. We question whether the Administrator would not

be justified under the Bill in finding a conversion "financially feasible" so long as it does not bankrupt the utility. In any event, the concept of financial feasibility does not adequately take account of the ability of utilities such as our companies to obtain the rates needed to finance the capital costs of coal conversion. Moreover, the lack of definition vests too broad a discretion in the Administrator.

While there are provisions in the Bill on temporary exceptions and exemptions, these in our judgment do not appear adequate to protect the interests of utility consumers and investors. The only exemption of continuing application which would be available to companies which use oil like the Northeast Utilities System is that in Section 105(e)(1) of the Bill. The conditions imposed on this exemption, however, could have most unfavorable effects on our customer charges. Thus, leaving aside the question of site limitations, which do not appear applicable to use, in order to qualify for an exemption we would have to establish both that the cost of using coal would substantially exceed the cost of using imported oil and that no alternative supply of power was available.

Two significant problems exist with the way this exemption is structured. First, in analyzing comparative coal and oil

costs, Section 102(14) of the Bill would require a reference to "any change in the use of existing electric powerplants in the relevant dispatching system." This is a proper way of analyzing cost. However, in New England, our generation is dispatched as part of the overall New England or NEPEX system, which will continue to be oil-fired to a major extent. Under NEPEX dispatch, if total costs of operating with coal are significantly greater than the cost of operating with oil, this would serve to increase the cost of operating our converted plants - although quite possibly not be enough to meet the "substantially exceeds" test of the exemption - and the result would be that NEPEX would reduce the level of operation of our converted plants and increase the level of operation of other New England plants, which are very likely to burn oil and are likely to be less efficient than our plants presently are. The one clear result would be to increase our customers' costs, but, because of the dispatch arrangements, such action may not produce significant oil savings and, at worst, might actually increase oil consumption.

Secondly, the question of comparative economics becomes relevant under the exemption only if "there is no alternative source of power". Section 105(e)(1)(C). Alternative sources

of power will almost always be available at some price. Unfortunately, however, the cost of the alternative is irrelevant to the availability of the exemption. Thus, it is likely that even if we could demonstrate that the costs of using coal would be two or three times the costs with oil, we would not be entitled to an exemption.

Finally, the Bill fails to face squarely the issue that has been of paramount importance to us in assessing the possibility of coal conversions. This is the issue of whether we can effect the large amounts of financing required for conversion without adversely affecting our nuclear expansion program. We need a regulatory climate in which we can obtain adequate rate relief to proceed with our nuclear expansion program and bear the large additional costs which coal conversion would impose. It has been our judgment that, in view of our own present weakened financial condition and our present regulatory circumstances, we probably will have to cut back on our nuclear program if conversions are required.

We believe that we are not alone in facing this problem of a potential adverse effect on our nuclear program. In view

of this, we urge that a provision be written into the Bill which will require the Administrator to credit the contributions already made to oil savings and which will be made in the future by a utility's nuclear plants, and to make a nuclear contribution like ours a basis for exemption.

We also urge that the Bill specifically require full hearings on the record, where the views and positions of all parties will be subject to the test of cross-examination. Such a requirement will ensure a full airing of the costs and benefits of a mandate to convert a plant to coal burning. In this way fairer and better decisions should be made, which will take full account of the impacts on consumers, investors and utilities. In addition, the Bill should clearly direct the FEA to make the environmental assessments which the National Environmental Policy Act requires when the FEA begins its consideration of whether or not to order coal conversion, instead of waiting until its administrative processes are nearly completed. Such a direction would ensure that the FEA properly considers environmental values and consequences and that environmentally sound decisions are made.

June 6, 1977

COMMENTS OF THE COMPANIES OF THE NORTHEAST UTILITIES SYSTEM
ON TITLE I, PART F
(Amendments to the Energy Supply and Environmental Coordination Act)
OF THE PROPOSED NATIONAL ENERGY ACT
(H.R. 6831; S. 1469 and S. 1472)

In 1974 the Energy Supply and Environmental Coordination Act (ESECA) (Public Law 93-319) was enacted which empowered the Federal Energy Administrator to prohibit by order any power plant or major fuel burning installation from burning natural gas or petroleum products as its primary energy source. Even though very few procedural safeguards are present in ESECA, it has proven to be difficult to administer at best, and at worst has been ineffectual and contrary in application to the purpose of the Act which was to reduce petroleum and natural gas dependence by mandating coal conversion. For example, in New England because of our unique regional power dispatching system, it may well be that forcing certain power plants to shift to coal will in fact increase the region's petroleum consumption, and cost, because of substitution of less efficient petroleum-fired units to meet cycling and loss of capacity requirements.

In the same fashion the coal conversion program mandated by the proposed National Energy Act also appears to be misconceived and unlikely to achieve the purpose of meaningfully decreasing natural gas and petroleum utilization. In addition, the proposed National Energy Act would further limit due process guarantees and public evaluation of any decisions made. The Federal Energy Administrator's discretion is greatly enlarged such that orders can be based primarily upon his being satisfied as to only a few of the applicable parameters, with very little weight being given to the impact of a mandated coal conversion on

the consumer or the economy or its adverse effect on other on-going programs to reduce petroleum and natural gas dependence, such as construction of nuclear power plants or solid waste utilization.

Northeast Utilities can speak with authority in these areas because its operating companies are now involved with the Federal Energy Administration in the consideration of six units to be converted to coal under the provision of ESECA before its extension expires on June 30, 1977. It is our inescapable conclusion that ESECA, and the coal conversion provisions of the proposed National Energy Act (Title I, Part F) do not accomplish the laudatory aim of decreasing petroleum and natural gas dependence in the production of power nor do they properly take into account the economic, social and environmental costs associated with a mandated conversion which must be evaluated on a site-specific basis.

Thus, we believe it would be appropriate to repeal rather than modify ESECA. However, assuming the concept which resulted in the passage of ESECA is still deemed valid, and because of our experience under ESECA, Northeast Utilities offers the following suggested modifications to the proposed National Energy Act to alleviate the present shortcomings:

Delete Section 601(Sec.105(a)(2)(A)) in its entirety.

Explanation

This amendment would remove the ability of the Federal Energy Administrator which would be granted by this Act to establish by administrative fiat by category those existing power plants which would be prohibited from utilizing petroleum or natural gas on a blanket basis with no consideration of the individual circumstances of any particular plant within a category or any due process guarantees to identify and resolve any attendant issues such as economic or environmental effects.

Add the following at the end of Section 601(Sec.105(a)(2)(B)):

"except that any existing electric power plant which was subject to an order issued pursuant to the provisions of Section 2(a) and (b) of the Energy Supply and Environmental Coordination Act of 1974 as in existence at the time of enactment of this Act shall continue to be subject only to the provisions of that Act."

Explanation

This amendment ensures that those utilities which are already involved in a coal conversion proceeding commenced under the Energy Supply and Environmental Coordination Act (ESECA) would not be subject to a generally duplicative proceeding under the proposed National Energy Act.

Modify Section 601(Sec.105(a)(2)(C)) as follows:

"Criteria. - The Administrator may issue an order pursuant to subparagraph (B) if he determines that -

"(1) the existing electric power plant on June 22, 1974, had or thereafter acquired or is designed with the capability and has

the necessary plant equipment to use coal or other fuel as an energy source;

"(ii) that the use of coal or other fuel by the power plant in lieu of natural gas or petroleum is practicable, cost effective, and consistent with the purposes of the Act to decrease natural gas and petroleum usage;

"(iii) that the prohibition under subsection (a)(2)(B) will not adversely affect the reliability and economy of service in the dispatching system of the power plant;

"(iv) that adequate and reliable sources of coal, coal transportation and waste disposal facilities will be available during the useful life of the existing electric power plant; and

"(v) that a suitable alternative plan to decrease natural gas or petroleum usage has not been developed for the system of which this plant is a part."

Explanation

The criterial for issuance of a prohibition order have been revised to reflect the types of determination which should be made to establish a reasonable and effective coal conversion program to accomplish meaningful reduction of natural gas and petroleum usage for the production of power while recognizing the necessity to consider economic and environmental impacts and the feasibility of accomplishing the same purpose through alternate construction and operation strategies.

Change the last clause of Section 601(Sec.105(a)(3)) to read:

"... unless the reliability and economy of service in the dispatching system will thereby be impaired."

Explanation

This amendment would require that a determination be made that a prohibition to increase the proportion of petroleum or natural gas used in a mixture with coal would not adversely affect either the reliability of service or the economy of service realized through a dispatching system.

Modify Section 601(Sec.105(b)(2)) as follows:

"Before issuing, modifying or rescinding an order issued under subsection (a)(2)(B), the Administrator shall give notice to the public and give affected parties the right to participate in an adjudicatory-type hearing on the record to provide and promote full disclosure of all pertinent data, views and arguments and to afford interested persons an opportunity for oral and written presentations of data, views and arguments."

Explanation

Recognizing that a correct decision is more likely to be made when parties whose interests will be substantially effected have been allowed to participate meaningfully in the decision-making process, it is recommended that an adjudicatory hearing be conducted to better provide and promote fully disclosure of all pertinent data, views and arguments.

In Sections 601(Sec.105(d)(3) and 601(Sec.105(e), delete the phrase

"to the satisfaction of the Administrator"

Explanation

These amendments would narrow the power of the Administrator to bring that power into conformance with traditional administrative principles to prevent the exercise of authority in an arbitrary or capricious manner.

Make the following modifications to Sections 601(Sec.105(d)(3)(B)) and 601(Sec.105(e)(1)(A)):

"... such as access to or the availability and cost of coal or coal transportation facilities or waste disposal sites."

Explanation

A specific physical factor which has not been considered as a criteria for coal conversion is the availability, accessibility, and cost of liquid and solid waste disposal sites. In addition, the availability and cost of coal supplies and transportation facilities are necessary determinations in any assessment of the feasibility of a conversion to coal. These amendments would specifically require the analysis of these factors to be included in the determination of whether to grant a temporary or general exemption.

Substitute the following for Section 601(Sec.105(e)(1)(B)):

"the conversion and use of coal or other fuel is not cost justified;
or"

Explanation

This amendment would clarify the provision in the proposed National Energy Act to ensure that a decision is not made without having considered a cost/benefit analysis and to remove any possible ambiguity as to the interpretation of the meaning of "substantially exceeds" as it might affect a local service area.

Add the following phrase at the end of Section 601(Sec.105(e)(1)(C)):

"there is no alternative supply of power which can be obtained without impairing reliability or unreasonably increasing cost of service; or"

Explanation

Although it is recognized that some sacrifice on the part of individual consumers or even regions of the country may be necessary to achieve a valid national energy policy, an exemption should be granted when the costs which must be borne by the customer because of conversion are excessive.

Add a new Section 601(Sec.105(e)(1)(D)):

"a suitable alternative plan has been developed to decrease natural gas or petroleum usage for the system of which this plant is a part."

Explanation

Since a major purpose of the coal conversion program is to decrease natural gas and petroleum dependence in the production of power, utilities which have already embarked or intend to embark on construction or operation programs which would reduce that dependence through means other than the increased utilization of coal should not be penalized or forced to bear further substantial capital costs merely because they choose alternatives other than coal or chose to use coal in stations other than those being subjected to a prohibition order. This amendment would credit a utility for that foresight and commitment in the determination of the necessity to order any of its plants to undergo a mandatory conversion to coal and is intended to provide an alternative ground for an exemption.

Modify Section 108 as follows:

"... because of investments or commitments made in other alternative methods to coal conversion which have or will significantly decrease natural gas or petroleum dependence."

Explanation

This amendment would authorize the Administrator to grant relief from a prohibition order directed at a particular electric power plant if the purposes of the act have or will be satisfied through the development and use of alternative methods for power production other than coal utilization at that specific plant, such as increased nuclear power, solar energy or solid waste utilization within that utility system.

Delete Section 601(Sec.112(a)(1),(2),(3) and (b) in their entirety.

Explanation

The traditional method of enforcing compliance with an administrative process is through a petition to the district courts of the United States to enjoin the violation of an administrative order. The imposition of a penalty of as much as \$50,000 or incarceration for one year per violation per day is unnecessary and unwarranted to ensure compliance with this act.

Portland Cement Association
June 3, 1977

Statement Submitted to the Energy and Power
Subcommittee of the House Interstate and Foreign
Commerce Committee, on the Coal Conversion
Provisions of H.R. 6831 (Part F)

The portland cement industry recommends that the Energy and Power Subcommittee eliminate provisions of H.R. 6831 that would mandate conversion to coal by industries now using oil and natural gas. Mandatory regulation of industrial fuel usage is inflationary, administratively burdensome, and totally unnecessary as far as our industry is concerned.

This position does not in any way dilute our strong support of essential national energy conservation programs and our recognition that such programs must be challenging. In fact, in the three years that the cement industry has participated in the Administration's voluntary industrial energy conservation program, this industry has moved dramatically -- and voluntarily -- to convert from oil and natural gas to coal as its principal process fuel.

In 1972 the cement industry utilized coal for only 38% of its fossil fuel needs. By 1976 -- under the voluntary program -- this figure had risen to 55%. In the same period, the industry's consumption of natural gas fell 41% and oil use declined 30%. These achievements were the result of management decisions that reflected both economic reality and a concern for national energy objectives. They did not result from government fiat.

A 1975 industry-wide survey conducted by the Portland Cement Association indicated that planned coal conversions will bring the cement industry's coal-burning capability to 90% of total capacity by 1980. The remaining 10% will be in localities (Hawaii, for example) where coal is not economically available or where plant sites cannot accommodate coal stockpiling facilities. With such demonstrated voluntary response, a mandatory program is obviously unnecessary.

The mandatory provision of H.R. 6831 would be administratively burdensome for both government and industry. More importantly, it would be highly inflationary. If conversion "deadlines" are mandated, industries would be forced to compete for a limited supply of coal-handling equipment. The inevitable result would be production bottlenecks and increased equipment prices. A voluntary program would minimize such disruptions. A mandatory program, by contrast, would produce small incremental benefits to the nation at an extremely high cost in inflation, equipment shortages, and added paperwork.

As a major energy user with a strong reliance on coal, the cement industry strongly recommends that the Subcommittee delete the mandatory coal conversion provisions contained in the Administration's energy proposals.

NEW ENGLAND POWER COMPANY

Telephone 617 366-9011

20 Turnpike Road, Westborough, Massachusetts 01581

May 19, 1977

The Honorable John D. Dingell
Chairman, House Energy & Power Subcommittee
Room 3204
House Annex No. 2
Washington, D. C. 20515

Dear Congressman Dingell:

At the suggestion of Jim Phillips who attended the recent FEA hearings in Boston regarding the issuance of proposed coal conversion orders to a number of New England utilities, I will describe our position relative to coal burning and our objections to the ESECA process. Our basic company position is quite simple - we want to burn coal and we believe we can burn it cleanly and save money for our customers. Our basic objection to the ESECA process is also quite simple - we believe it will result in needless expense for our customers.

First, by way of general background ---

Our company burned coal as a primary fuel until the late 1960's when we converted to oil. During the early 1970's Federal and State air pollution regulations evolved and, in Massachusetts, a State Implementation Plan (SIP) was formulated on the basis of requirements that oil burners could meet without extensive plant modifications. The blessing of the SIP by EPA resulted in a stringent set of air quality rules for oil burners - and I'm sure since there were no coal burners in the state - no one envisioned the impact of that SIP on future coal burning.

During the oil embargo in 1974 we reconverted our units with coal burning capability back to coal on a crash program and in 1974 and 1975 burned 1.5 million tons of coal. Because the air quality rules had changed from our prior coal burning days, we were allowed to burn coal only under strict variance and suspension conditions - and it is important to note that at no time were primary standards violated in our area of impact. Because our variances and suspensions could not be extended beyond a statutory deadline date of June 30, 1975, we reconverted the units back to oil.

This little bit of history is significant because it points out the irony in the coal conversion dilemma. We voluntarily converted to coal, met primary standards and saved money for our customers via

the fuel adjustment provision in our rates (coal was less expensive than oil). Now we are about to be ordered to burn coal, must meet a SIP designed for oil and the net result will be higher costs for our customers. The higher cost derives from a choice of burning coal conforming to the SIP - a coal cost higher than our oil cost - or installing pollution control equipment whose cost could exceed \$250,000,000. I would point out that the regions in which our two major plants are located have ambient SO₂ levels only 60% and 30% of the primary standards for SO₂.

We have and will continue to work toward reasonable change in air quality regulations - with these changes we feel that some of our units can again burn coal economically. Given this condition we will voluntarily switch back to coal. In the meantime, we continue to resist forced conversion that entails needless expense for our consumers.

Regarding the ESECA process - we have objections to some provisions of the law and the FEA's actions within its framework. Rather than detailing these objections, however, it might be more useful to point to changes that should be incorporated in ESECA or follow on legislation:

1. From an environmental standpoint the target is moving so quickly (e.g. nonattainment, nondeterioration) that one is never quite sure what the rules are and converting to coal poses huge investment risks. Many of the current debates and issues will take years to resolve. To expedite and encourage conversions, potential coal burners should be permitted to burn - and environmental regulatory groups should be directed to support - the burning of as high a sulfur coal as ambient conditions will permit up to the primary standard for SO₂. In addition, new legislation must provide a period of certainty under Federal and State clean air standards for utilities making an investment in coal conversion facilities. This concept is sometimes called a "grandfather clause" and is exemplified by Section 306(d) of the Federal Water Pollution Control Act, which provides that industries meeting "new source" discharge limits shall not be subject to any more stringent standards for ten years following completion of construction. (In the case of coal conversion, the remaining useful life of the plant would be a more appropriate period). Such a provision would eliminate the substantial risk which now exists that such an investment might well be rendered worthless by constantly changing environmental standards.

2. Coal conversion should not be required where it would result in an economic cost penalty to the utility or its customers. The current standard of conversion if it is "practicable" is entirely too vague and unworkable. Any additional costs imposed by coal conversion should not be paid solely by the affected utilities and their customers but should be distributed throughout the nation through federal grants or tax write-off provisions so that the benefits of making our country "energy independent" are paid for by all of its citizens, not just some.

3. The current ESECA "two step" process, whereby FEA first issues a Prohibition Order and EPA then makes its Clean Air Act findings, is cumbersome and difficult. FEA cannot make valid cost and other findings until EPA has specified the applicable limits. The two agencies should be required to work together in advance of any conversion attempts so that all issues can be dealt with in a single proceeding which deals realistically with the problems. In addition, the required environmental impact statements should be available before the conversion proceedings begin so that environmental constraints will be known.

4. Prior to any conversion efforts, FEA and EPA should be required to make public their detailed factual findings as to the costs and benefits resulting from conversion. FEA's current attitude of releasing documents only after the proceeding is commenced, and not preparing an analysis which backs up its findings with facts, encourages shoddy government decision making and makes extensive litigation inevitable. All relevant data should be "put on the table" so that the utilities and the public may scrutinize the basis for a conversion decision.

5. Any conversion of utilities which are part of a centralized "power pool" system - as is the case in New England - should be preceded by an analysis of the effects of conversion on such system, as well as on the individual plants. Without such an analysis, the true costs and benefits of conversion can never be understood.

6. An opportunity should be provided to the utility for cross-examination of the FEA and EPA "experts" who prepare the necessary findings for conversion. A full-scale evidentiary hearing would be desirable, but even limited opportunity for cross-examination would be a vast improvement over the current law. Although it might be argued by some that such a procedure would slow down the conversion process, in fact, it will speed it up because government decisions will be made on a more realistic basis if those making them understand that their rationale is subject to a genuine critique. This will result in a more realistic approach to conversion by the regulatory authorities and, therefore, greatly reduce the litigation which is unavoidable where no mechanism exists for a thorough examination of the facts prior to a conversion initiative.

The preceding suggestions are directed toward overcoming some of the weaknesses of current mandatory conversion legislation. Of deep concern to me - after witnessing the unproductive and perhaps counter-productive pursuits under ESECA - is whether any mandatory conversion program on existing generating plants can be very effective. If we focused our attention on removing impediments to voluntary, economic conversions, I believe the taxpayer and utility customer

would come out far ahead and we would see coal conversion effected more rapidly and in greater numbers.

I hope these observations are helpful and if we may be of any further assistance in this matter, please let us know.

Very truly yours

A handwritten signature in dark ink, appearing to read "J. F. Kaslow". The signature is written in a cursive style with a prominent initial "J".

J. F. Kaslow
Vice President

Stauffer Chemical Company

Westport, Connecticut 06880 / Telephone (203) 226-1511 / Cable "Staufferchem"

June 6, 1977

Honorable John D. Dingell, Chairman
 Subcommittee on Energy and Power
 Committee on Interstate and Foreign Commerce
 Room 3204 Annex No. 2
 2nd and D Streets, S. W.
 Washington, D. C. 20515

Re: H.R. 6831, The National Energy Act

Dear Mr. Chairman:

Stauffer Chemical Company has previously reviewed the coal conversion legislation proposed by Senator Randolph, and as subsequently revised by Senator Jackson. We have worked with the Senate committees and staff in an effort to develop a bill which would give the results desired in the most beneficial and least disruptive manner.

Based on the background and experience we have gained from the above, we would like to offer the following comments on the revisions to Title I of the Energy Supply and Coordination Act that are proposed in H.R. 6831:

1. Only new industrial and utility boilers of 250 million BTU/hour design heat input and over should be required to burn coal. Only existing boilers of that size which have burned coal or are equipped to burn coal should be required to convert to coal. It is not practical to convert boilers designed to burn oil and gas so that they will burn coal.
2. Industrial combustors should not be required to burn coal. The amount of oil that would be saved is not significant, and even when technology permits the cost is prohibitive. Direct fired retorts, cracking furnaces and process heaters, particularly those depending on radiant heat, are not capable of burning coal, and in most cases cannot be designed to do so. Even when there is not direct firing, temperature control is not sensitive enough to control the process, and flame and heat release characteristics are unsuitable. The only manner in which coal could be used would be by coal gasification - clearly not the intent of this section,

entirely too expensive on a small scale, and not yet proven technology. Unlike a boiler house, process combustors cannot be centrally located, so that even when it might be technically feasible to construct equipment to use coal, the cost of multiple coal handling and flue gas environmental control make the use of coal prohibitively expensive.

3. The Federal Energy Administrator should not be given the authority to lower the size limitation adopted by Congress, or to arbitrarily rule that certain industrial equipment or processes must convert to coal or that certain installations are to be defined as MFBI's.
4. Most industrial boilers can be converted from natural gas to fuel oil to save natural gas. Not all process combustors can use natural gas, however. The present FPC regulations on end use curtailment of natural gas recognize, in FPC Order 476B that for certain process uses other fuels such as petroleum cannot be substituted. The proposed law should adopt those provisions.
5. The power plant or industry which has constructed its own pipeline to transport natural gas for its own use should be allowed to increase the price of gas sold because of a prohibition to recover the pipeline cost allocated to such gas.
6. We consider it unconscionable that the Administrator would be allowed to refuse an exemption and then allocate coal to a person when a person subject to a prohibition demonstrates in a request for an exemption that coal is not available.

We appreciate the opportunity to comment on this bill, and respectfully request that you include our views and comments in your consideration of this highly technical and vitally important section of H.R. 6831.

Very truly yours,

D. M. Greeno

D. M. Greeno
Director, Energy Management

DMG:dw

[Whereupon, at 4:20 p.m., the subcommittee adjourned, to reconvene at 10 a.m., Wednesday, June 1, 1977.]

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PART 5
NATIONAL ENERGY ACT

HEARINGS
BEFORE THE
SUBCOMMITTEE ON ENERGY AND POWER
OF THE
COMMITTEE ON
INTERSTATE AND FOREIGN COMMERCE
HOUSE OF REPRESENTATIVES
NINETY-FIFTH CONGRESS
FIRST SESSION
ON
H.R. 6831, H.R. 687, H.R. 1562, H.R. 2088,
H.R. 2818, H.R. 3317, H.R. 3664, H.R.
6660, and all similar and identical bills
BILLS TO ESTABLISH A COMPREHENSIVE NATIONAL
ENERGY POLICY

JUNE 1, 1977

Serial No. 95-26

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Committee on Interstate and Foreign Commerce

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NATIONAL ENERGY ACT

WEDNESDAY, JUNE 1, 1977

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND POWER,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to notice, in room 2123, Rayburn House Office Building, Hon. John D. Dingell, chairman, presiding.

Mr. DINGELL. The subcommittee will come to order.

The subcommittee meets today to conclude 3 weeks of hearings on H.R. 6831, the President's proposed National Energy Act. Previous hearings have focused on the residential insulation program, appliance standards, conservation in schools and hospitals, natural gas policy, public utility regulatory policies, and amendments to the Energy Supply and Environmental Coordination Act.

Today's hearings are intended to let us take a step back from the details of the many components of the President's plan and take a broad and longer term view of the plan as a whole. What are the goals of the plan? Are production and conservation goals properly balanced? Do the various regulatory, tax, and price components of the plan provide coordinated incentives to move toward those goals? Does the plan build properly upon existing energy law, or does it threaten to lead to excessive government interference in the daily choices of energy consumers?

The past 3 weeks of hearings have elicited substantial criticism of the many costs and burdens that would accompany the President's program. This is largely because the costs of conservation and conversion to coal precede the benefits by several years.

Presumably, the President believes that the long-term benefits of his plan will more than offset the short-term costs. But what are those benefits? And when will they be realized? Maybe a better way of putting the question is this: What are the costs of not adopting the President's program and merely following current policy? Will current policy lead to a higher level of oil imports? What are the economic and national security implications of the differential in import levels associated with the President's plan versus current policy?

While the President's program is generally regarded as a conservation initiative, its greatest impacts in 1985 occur as a result of

(1)

coal conversion. As described in the National Energy Plan, the program aims to reduce oil imports in 1985 by 4.5 million barrels per day. Conservation reduces demand by roughly 1.9 million barrels per day. Coal utilization in 1985 is projected to increase so as to displace the equivalent of 2.3 million barrels of oil per day under the President's program. So more than 50 percent of the measurable impact on oil imports is due to coal conversion. We must ask how this high priority on coal use matches with other national environmental goals, particularly for clean air and strip mine controls.

James R. Schlesinger, Special Assistant to the President, and William D. Nordhaus, a member of the Council of Economic Advisers, will appear on behalf of the administration to address these important concerns. Another concern is the potential inflationary and recessionary effect of the program. How will total output of the economy be affected? What will be the impact on jobs? Dr. Alice Rivlin, Director of the Congressional Budget Office, will help in evaluating these difficult questions.

Finally, our hearings this afternoon will address the long-range implications of the President's energy program and energy policy alternatives. While the analysis prepared by the administration looks to the impact of the program in 1985, one expects that any significant long-term effects are only beginning to emerge in 1985 due to the long lead times involved in raising national energy efficiency and accumulating coal-using capital equipment.

As many of you already know, the subcommittee is operating under extraordinary time limitations. Markup on title I, part A, will begin tomorrow. Our objective, which cannot be easily met, is to finish subcommittee markup on title I on June 17. Full committee markup would begin on June 21 and finish by July 13 if the Speaker's timetable is to be achieved.

The Chair indicates that the subcommittee, and I am sure the full committee under the leadership of Mr. Staggers, will make every effort towards that end.

It is unfortunate that time permits only 1 day to be devoted to critically important hearing on the overall goals and impacts of the President's plan. Clearly, the issues are complex and do not lend themselves to simple or quick resolution. I hope that we can obtain today a better sense of the positive overall design of the plan so that markup will proceed on a constructive path, with long-term benefits properly factored against short-term costs.

The Chair is delighted that we have here with us Dr. James Schlesinger. The Chair observes that Dr. Schlesinger appears as an extraordinary courtesy to the committee in view of his difficult time schedule, and also in view of the fact that he is technically a member of the President's personal staff.

Dr. Schlesinger, we are particularly appreciative of that, and of your kindness in making available to us from your limited amount of time the opportunity to inquire of some of the questions raised by the Chair. We are particularly pleased to see Mr. Les Goldman with you, who is a respected former member of the staff on the Hill, and a very dear and old friend of all of us on this committee, Mr. Nordhaus, who is an extremely able and respected member of your staff.

Gentlemen, we are pleased that you are with us.
 Doctor, if you wish to proceed, we will recognize you.

**STATEMENT OF HON. JAMES R. SCHLESINGER, ASSISTANT TO
 THE PRESIDENT, EXECUTIVE OFFICE OF THE PRESIDENT; AC-
 COMPANIED BY LES GOLDMAN, ASSISTANT ADMINISTRATOR;
 AND ROBERT NORDHAUS, ENERGY POLICY AND PLANNING
 OFFICE**

Mr. SCHLESINGER. Thank you, Mr. Chairman.

Mr. Chairman, the Nation faces a challenge. We are operating under tight deadlines, as you have observed. Our staffs have been working overtime.

If we had sufficient time, of course, we could spend months and years in deliberation, but we face a national challenge, and the time to begin to act is now.

I will discuss today the basic direction of this program. I think that everybody on the Hill, and in the executive branch, agrees that the basic direction of the program is correct. There will be differences about detail, but there is recognition that we must begin to make a transition now to a future in which the degree of dependency on oil and gas will have to be reduced. If we make that transition now, and make it smoothly, we can avoid severe economic, political, and social effects in the 1980's when we reach a limit of production capacity around the world with regard to oil.

The severity of the challenge that we face is reflected in that future oil production. The world will probably never exceed 75 or 80 million barrels a day of production. At the current American rate of consumption per capita, we would exhaust all of the reserves that the oil geologists in their wildest dreams ever expected would be found and could be recovered in 15 years. At a growth rate of 5 percent a year, we will reach a capacity limit by the middle 1980's, so we face a situation in which we must begin to make the adjustments now if we have foresight, if we have vision, and we must operate as a united country in order to do so.

The President has called for the moral equivalent of war. That does not mean, as it has been misinterpreted, that we need to turn to wartime measures, or go on a war footing, in order to grapple with this problem. The stress is on the moral equivalent of war, the achievement of national cohesion, a drawing together of all of our interest groups, peoples and regions, in order to respond to this national problem.

As I understand from your opening remarks, Mr. Chairman, we have not yet achieved that degree of cohesion, and as predicted, there has been a good deal of criticism along the lines of "Yes, we need to have a plan, we need to respond, but the particular part of this plan that may affect me is the unwelcome part of the plan." We cannot deal with this issue by picking apart the details of the plan. It is a comprehensive whole, and we do face a problem that our primary reliance on oil and gas will have to be diminished in the future. Right now it runs 75 percent of our total energy. In the future, we will have to begin to choose to use fuels more in terms of their highest and best use.

Natural gas obviously has its highest and best use in residential heating. Oil will have to be increasingly used to maintain our transportation sector, and as a consequence, for stationary sources we will have to go over increasingly to coal. It is necessary for us to begin to act now if we are to be prudent, if we are to take out insurance against a difficult future.

We can recognize two things. First, that making these adjustments now, as the witnesses before this committee have indicated, will not be entirely painless. It is far less painful to drift along for a few years longer, putting off the day of reckoning when we must begin to make those adjustments, but unless we begin now to alter our stock of capital from its excessive dependence on oil and gas, and its high use of energy per unit of output, conservation, we will face a much more difficult point of decision in the 1980's as we begin to run short of the fuels of primary choice. Then we will face a problem not of adjusting our stock of capital, but an interruption in the flow of goods and services, a decline in per capita incomes, a rise in unemployment, and an acceleration of the rate of inflation.

If we have vision and foresight, we will begin to make that adjustment now. That is what the President's plan is intended to do. Since we have time to react, let us make use of that time, as best suits our purposes, rather than drifting along for a few more years with a policy of too little and too late. We should avoid listening to the soothing lullabies that somewhere out there there may, may indeed, be more oil to be found.

The record of prediction in this area, Mr. Chairman, is pretty spotty. The National Petroleum Council some years ago, for example, indicated that if only the Nation gave a price of \$6 or \$7 a barrel, and at that time the price was \$3 a barrel, that we would be able to produce all of our needs domestically in some near term. Right now the price is \$11.28 a barrel for upper tier oil. For frontier oil we will be offering \$13.50 a barrel, but there will be no substantial flow of oil. We face the fact that domestically we are running out and that in some 10 to 15 years time, the entire world will peak out in terms of production, so let us not listen to those soothing lullabies that somehow we can make it all painless. Let us face up to the transition now.

The President's program established seven goals that are attainable if we take the appropriate steps. Some of those goals are more difficult to achieve than others and may require additional legislation at a future date to assure that indeed those goals are made, but we have time now, and we have proposed to the Congress legislation that depends ultimately on the essential free choice of corporations and of individuals to make adjustments through the price system. This will require major adjustments in the prices facing corporations, somewhat lesser adjustments in the prices facing consumers.

Consumers are helped to make adjustments in home heating and automobiles by mechanisms other than the price mechanism, but we must have the price mechanism working for us rather than against us, and we must make this adjustment in a way that is consistent with our free society and with a free economy.

The transition now can be primarily through the free choice of corporations and individuals. If we fail to take action now, that is likely to change, much to our regret.

Mr. Chairman, you mentioned the question of what will be the costs of not following the plan of the President. Those will be serious. We have heard much discussion of the economic consequences of the plan. It will bring about an increase in the rate of inflation of something on the order of a quarter of a point per year, but if we fail to take action, the failure to take action will have drastic economic consequences in the middle 1980's.

We have a number of goals. We can indeed reduce our energy growth below 2 percent a year. The measures before you will reduce it to 2.2 percent a year, and reduce our importation of oil to some 7 million barrels a day. Above that, we are asking for voluntary measures on the part of the American people that will further reduce oil consumption by 100,000 barrels of oil a month, and pull the importation of oil below 6 million barrels a day, and it would also reduce total energy growth to less than 2 percent.

The achievement of the reduction of gasoline consumption by 10 percent by 1985 from 1977 levels is embodied in this legislation. Not only can we increase coal production by at least 400 million tons, as the President has suggested, the legislation before you and our projections suggest that coal production would actually increase by 565 million tons. That is once again necessary to move away from oil and gas and towards coal.

We hope to achieve insulation of 90 percent of our homes as well as all new buildings. The legislation before you, according to Treasury estimates, will achieve 60 percent insulation, and we may be back to you at a later stage when that queue has diminished for additional measures if the willingness to insulate additional homes flags. Finally, we expect to see, according to Treasury projections, the use of solar energy in 1.3 million homes as a result of the proposed tax credit, compared to our goal of 2.5 million homes, but once again we will be back to you for additional measures.

Mr. Chairman, this program is basically one that reflects the use of voluntary measures, the use of the price mechanism, to reinforce decisions by individuals. It depends in part on tax changes which do not lie presently before your committee, but the program is a comprehensive whole. It will affect the future of our children and grandchildren. Future generations will judge carefully how well we in the government, both the legislative branch and the executive branch, responded to this emergency. Mr. Chairman, I welcome the opportunity to appear before this committee to provide a view as to the overall nature of the plan, rather than what is perfectly natural, a tendency to pick at particular elements of the plan that affect this interest group or that interest group. We must respond to this as a united country. We cannot afford division according to the lines of interest groups, economic groups, and regions of the country.

Thank you, Mr. Chairman.

Mr. DINGELL. Doctor, the committee thanks you for being here with us this morning. I think it is extremely important that we have the opportunity to have this last interchange before we commence the markup. It will be extremely helpful, I think, in clearing the air and affording the members an opportunity to raise questions.

I appreciate the great concern with which you and the administration view this problem and the urgency with which you solicit speedy action by the Congress on the markup of the presentation of the legislation through the administration.

The Chair now recognizes members according to the order of their appearance. The Chair recognizes first my friend and colleague from Indiana, Mr. Sharp.

Mr. SHARP. Thank you, Mr. Chairman.

Mr. Schlesinger, I certainly appreciate your remarks, and share your view that we have to act now and we have to act like a nation instead of a group of struggling interests who can't ever rise above our own self-interest.

On Sunday you may have seen in the Washington Post an article by Barry Commoner which took, in a couple of fundamental instances, exception to what the claims for the President's plan are, and, it seems to me, it might be worth your responding to those.

As I recall, there were two such claims. One was that what essentially is involved, and he even used the term "allocation," is that this would allocate energy away from residential and he used the term "consumer," I think he meant residential area, to the industrial sectors of our economy, and therefore in his view, it was unfair to consumers.

Secondly, he took the view that embodied in the plan, or at least the result of the actions that we will take is really, as he called it, a hidden commitment to a nuclear policy, which in his view we could never then switch by the year 2000 towards solar because of the enormous capital investment and the commitment to the electrical industry.

I wondered if you would care to respond to those two claims since I suspect we will hear them time and again.

Mr. SCHLESINGER. Thank you, Mr. Sharp.

There is no intent to allocate energy resources. That will continue to be done on the basis, by and large, of the free choice of individuals and corporations. What we are attempting to do is to conserve dramatically on the use of energy in comparison with the past growth rates; and that, I believe, is a goal that Mr. Commoner fervently shares. He fears that we may not have gone far enough along those lines, but as to the division between household users and corporate users or industrial users, there is no allocation. What we are attempting to do is, through assistance to the household, dramatically reduce the requirements for household consumption of energy. The insulation of homes will permit us to reduce oil and gas use in individual homes, by somewhere between 30 and 50 percent, depending on the home in question, and that should reduce substantially the aggregate requirement for energy and at the same time should restrain the growth of fuel bills for the consumer.

This program has been designed to assist the consumer. Price increases affect the consumer only slowly and to a far lesser extent than they affect industry. The program has been shaped to protect the consumer.

In the area of automobile use, of course, the household consumer will be using less because we are moving towards more fuel-efficient cars, but the fact that we are able to reduce significantly the

prodigal use of energy in the home is a national benefit and a benefit to the consumer in terms of his bills.

On the industrial side, we face two trends. First, we hope to reduce substantially the growth of energy per unit of output, and we have proposed a variety of conservation devices in order to achieve that, including higher prices for industry, and industry does keep a fairly sharp pencil.

Industry, unlike the household consumer, will be urged to make the transition to coal. The household consumer will have first priority on the use of natural gas; and, to the extent that he is part of the transportation sector, he will have first priority on the use of oil. Industry will be pushed, at some cost to industry, to using coal, which is a less efficient fuel in a number of respects. However, as we move industry away from oil and gas towards coal, and at the same time we urge industry through price measures and through ancillary regulatory devices to conserve more, we want the American economy to continue to grow. We need to have growth in the American economy. It should grow at 5 percent a year according to the projections. It is axiomatic in this plan that we must have more jobs for the American population, and, as a result, the industrial use of energy will continue to grow. In terms of energy consumption per unit of output, it will shrink; but the proportions will change as between industry and the household because we are effectively conserving in the household to the benefit of the consumer and we are permitting the expansion of industry to the benefit of the American people at large.

Mr. KRUEGER [presiding]. Sorry; I thought you were finished, Mr. Schlesinger.

The time of the gentleman has expired.

Mr. SCHLESINGER. No, sir. The other question was the question of the allegation of a hidden commitment to nuclear. There is no hidden commitment to nuclear. There is an open commitment that the Nation must move its utilities away from oil and gas to other fuels. In the near term those are coal and nuclear. We have endorsed the light water reactor as an appropriate option. We are not, however, proceeding with the development of breeder technology. In the short term we will continue to develop the technology, but we will not commercialize it.

None more fervently hope that we will be able to prove out solar electric production than do the members of this administration. If so, we will be able to terminate the use of nuclear power with the presentation of light water plants.

In the longer run, we may be able to develop fusion. If we are unable to develop fusion, if solar electric proves to be unpromising, and we hope that it will not, we may be forced to continue with nuclear fission; but there is no hidden commitment to that. The commitment is to the vigorous development of the technologies of solar power and of fusion power to develop the options to avoid continued reliance on nuclear fission.

Mr. KRUEGER. The time of the gentleman from Indiana has expired.

Recognizing in order of appearance, the Chair recognizes himself for 5 minutes.

Mr. Schlesinger, I am sure that the Congress is not less interested in a comprehensive energy view than the administration.

Mr. SCHLESINGER. Yes, sir.

Mr. KRUEGER. And I know that your statement was not intended to imply anything otherwise.

I wonder in connection with the conversion to coal, which is a kind of keystone for the administration's proposal, I have had a staff member do some rough figures on what it would mean in terms of atmospheric pollution if, for example, we converted 1.5 trillion cubic feet of natural gas to coal for the production of electricity, and if we assume that a standard amount of sulfur in coal, not the most high sulfur coal, and if we assume that this coal produces 15,000 Btu per pound, and 4 percent sulfur content in coal, then even if we assume the best available control technology in which some 90-odd percent of the sulfur would be removed, figures that we get are that by converting 1.5 trillion cubic feet of gas to coal, we would be adding 800 million pounds of sulfur to the atmosphere, or about 4 pounds of sulfur for every man, woman, and child.

Now I am in concurrence that we will need to convert increasingly from gas and oil to coal for the production of electricity, but I wonder whether this kind of problem of substantially different atmospheric pollution is one that the proposed Department of Energy has addressed because I never found it really addressed in the President's message and it is a problem that I think the Congress persistently needs to deal with as we deal with the Clean Air Act and clean air legislation. I wonder, though I have one other question, whether you would comment on that particular problem.

Mr. SCHLESINGER. Yes, sir. As you indicate, the administration supports the use in the near term of the best available control technology, which is only the best available. There is no permanent solution. In the longer run we hope to develop fluidized bed combustion in widespread use which will more effectively deal with the problems of unfavorable emissions.

We have carefully reconnoitered with EPA the problems that you have mentioned. We estimate that by 1985, as a consequence of the coal conversion program, sulfur oxide emissions would increase by a maximum of 5 percent nationwide. We will have to work on the 1.5 trillion cubic feet of natural gas, and insert in the record just what the consequences of that will be, whether indeed your figures are similar to our figures. [See p. 12.]

We would have a 5-percent increase at maximum of sulfur oxide emissions as a result of the coal conversion program. If we do indeed achieve the 565 million extra tons, which we project, that will result from persuading industry to make those transitions. We estimate that 44 percent of new facilities will be coal fired. Ten percent of existing facilities will make the conversion to coal.

Mr. KRUEGER. The record will, without objection, be held open for additional figures to be supplied.

In particular, it would be helpful, I believe, if we could have additional figures on the total amount of both sulfur to be added to the atmosphere by, say, 1985, and also I noticed in this morning's

newspaper that there were some problems suggested in carbon dioxide levels. [See p. 12]

Mr. SCHLESINGER. Carbon monoxide?

Mr. KRUEGER. I believe carbon dioxide levels as a result of the burning of coal, and the article in this morning's paper suggested we might have a 4-degree temperature change as a result. That was one of the local dailies called the Washington Post. If you might look at that, and then if there are any comments on that, I would appreciate that.

[The following information was received for the record:]

The Administration is not of the opinion that carbon dioxide generation occurring as a result of the *National Energy Plan* is likely to become a serious problem, even in the longer term. Carbon dioxide is a natural respiration product of plants and animals, including humans. The gas is also produced as the end product of combustion and/or oxidation of any compound containing the element carbon. Carbon dioxide is generated not only by the burning of coal, but also by the burning of gasoline, fuel oil, or natural gas, although CO₂ emissions are about 80 percent higher on a Btu equivalent basis when burning the former. The additional CO₂ generated as a result of the NEP, however, would be small compared to current concentrations. Conversion of the full 3.3 MMb/D expected under the Oil and Gas Replacement Program would increase the amount of CO₂ in the atmosphere by less than 1 percent.

The Administration does not wish to minimize the seriousness of the possible long-term effects of increased generation of carbon dioxide. The problem should not be substantially affected by the provisions of H.R. 6831. However, this will obviously be a central issue in our study of the health effects of increased coal production and use, as called for by the *National Energy Plan*.

Mr. KRUEGER. I believe I have time for one more question. That one question concerns the soothing lullaby.

Another journal recently, *The Wall Street Journal*, indicated that the Energy Research and Development Administration foresaw very substantially larger quantities of natural gas than has been suggested in the President's message, and in an editorial called "1,001 Years of Natural Gas," and in succeeding editorials called "ERDA Gate" and one other implied that there was the possibility that the administration might be interested in suppressing and withholding information about this particular ERDA study, and I am sure the Congress will wish to get back to that but would you care in the short run to make any comment, if you are familiar with these suggestions, that the administration has in fact suppressed an ERDA study that would suggest that there are from 20,000 to 50,000 trillion cubic feet of natural gas more than was proposed in the President's message?

Mr. SCHLESINGER. Mr. Chairman, let me make an initial observation with regard to the greenhouse effect and carbon dioxide. The way to deal with that problem is through conservation. The more effectively we conserve on the use of energy, the more efficiently we use energy, the less will be the production of carbon dioxide, and consequently the less will be the greenhouse effect. So to the extent that we worry about that problem, it points to a clear remedy. Conserve more rather than less.

With regard to the suspicion of conspiracy and suppression of a report, suspicion of conspiracy seems to be developing in the oddest places these days. The report has been available apparently to *The Wall Street Journal*.

Let me emphasize the point that is left out of the editorials that have appeared in *The Wall Street Journal*. Those are technologies

that have not as yet been developed and on which the government is working energetically, putting major resources, for example, into the development of Devonian shale, into geopressurized brine. We fervently hope that, indeed, we are able to make these sources for the production of gas economically effective; and, if so, the gas situation in the United States will be far better than the prudent estimates in the report, which are based upon the conventional sources of natural gas.

We will energetically pursue those new technologies but we will not count our chickens before they are hatched or our new sources of natural gas. Indeed, if we are able to use Devonian shale, tight formations in the West, or geopressurized brine, we shall be happy to do so. First, however, we have to develop the technologies that will bring that gas in at a respectable price, which we would expect to be on the order of, perhaps, \$4 per Mcf, if we can develop the technologies, but it is inadvisable for us to base our policies on technologies that we have yet failed to develop.

Mr. KRUEGER. The time of the gentleman from Texas has expired.

The Chair next recognizes the gentleman from Colorado, Mr. Wirth.

Mr. WIRTH. Thank you, Mr. Chairman.

Mr. Schlesinger, I have two questions, one related to an overall conservation approach, and the second related to the set of air pollution problems illustrated by the decision on the floor of the House on automobiles last Thursday. Let me take those one at a time.

If we are really concerned about limiting the amount of oil used in this country, and concerned about limiting the amount of oil that is imported in this country, why don't we simply say that, starting in 1978 we have a factor of 100 barrels being imported into this country, and in 1979 we are going to then have 99 and move it right back in that kind of a fashion, just by saying we are not going to import any more oil? Did you all consider doing that, taking an approach like that?

Mr. SCHLESINGER. No, but we will reflect on that, Mr. Wirth. The problem with establishing an import limitation, unless the economic underpinnings have been adjusted to it, is that it will result in a bidding up of prices, and if there are controls, as there are at the present time, this will result in the development of a black market, but it may be desirable for the Congress to review the possibility in relation to the reduction of oil imports to 5.8 million, that indeed we have an annual goal established, and we would be happy to work with the Congress on that.

Mr. WIRTH. There are a number of us on this subcommittee and in the Congress who are interested in this approach, having, over the last 2-1/2 years, thought of just about everything else. Now it seems to me we may have the underpinnings in terms of legislation, in terms of entitlement programs and so on, that would allow us to move on a percentage reduction of this kind. We will get back to you on that, but that was not considered in the development of this program or was not analyzed in any depth by the administration?

Mr. SCHLESINGER. We have an implicit goal for the reduction of imports, but we did not tie that to an import limitation.

Mr. WIRTH. If I might, Dr. Schlesinger, let me jump to the second issue, and that relates to the emissions standards voted on by the Congress last Thursday, and the relationship which those might have, and I think probably do have, to the President's coal conversion program. I think all of us agree with the importance of the coal conversion program and would be concerned as to how much we can in fact pollute the atmosphere. I would assume that in the development of the administration's coal conversion program, that you made various assumptions about how much pollution the atmosphere could handle; is that not correct?

Mr. SCHLESINGER. We have made some estimates as to the impact on atmospheric pollution. The additional impact is minimal from stationary sources, and overall, as a result of the reduction of projected automobile pollution, the quality of the air would improve, I believe, but I shall have to check that for the record.

Mr. WIRTH. Therefore what you are saying is that as we move from what I understand to be your goal of 800 million tons a year to 1.2 billion of coal being burned, that that would not significantly add to air pollution in this country.

Mr. SCHLESINGER. As I mentioned to the chairman, that would add approximately 5 percent to the sulfur oxides in the atmosphere in the country, 5 percent nationwide. It would add 1 percent to particulates, assuming once again the best available control technology, but that is from those sources that would be changed. It does not include other sources, including the automobile, and we should have to make an aggregate judgment on that.

Mr. WIRTH. In testimony last Friday, Mr. Costle of EPA said that he was very concerned about the aggregate pollution that we were now talking about. If in fact we were adding so much in terms of sulfur oxides, so much in terms of particulates, are adding so much NOx and so much carbon monoxide, we in fact might be causing the American public very severe health problems at a time when lung cancer is already becoming an epidemic in this country.

What kind of an analysis should we be looking at on that front so that we can better understand, given the constraints placed on pollution that came out of the congressional action on automobile standards last week, how much can we allow in terms of coal conversion. Shouldn't we have that information as quickly as possible here in order to make a decision on the package set forth by the administration?

Mr. SCHLESINGER. We will work with you, Mr. Wirth, on that. I should point out that EPA has worked closely with us on these estimates, that the overall direction for air quality should be upward as a result of the improvement of the available control technologies, but let me emphasize once again that we have no alternative but to begin to make that transition.

Mr. WIRTH. I agree with you completely but my concern is that while we make that transition we are letting one industry in this country get away with more than their fair share of how much pollution you can put up in the air. That is the basic concern that I have, and I think that it is our obligation to make sure that those sets of trade offs are made clear to the people of this country.

Thank you.

Mr. SCHLESINGER. We shall insert some material, Mr. Chairman, in the record, in response to Mr. Wirth's question.

Mr. DINGELL. Without objection, it is so ordered.

[Testimony resumes on p. 63.]

[The following document was received for the record:]

AIR POLLUTION IMPACTS OF
THE OIL AND GAS REPLACEMENT PROGRAM
IN THE UTILITY AND INDUSTRIAL SECTORS

EXECUTIVE OFFICE OF THE PRESIDENT
ENERGY POLICY AND PLANNING
AND
ENVIRONMENTAL PROTECTION AGENCY
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**AIR POLLUTION IMPACTS OF THE OIL AND GAS
REPLACEMENT PROGRAM IN THE INDUSTRIAL
AND UTILITY SECTORS**

I. EXECUTIVE SUMMARY

The purpose of this paper is to present the results of analyses of air pollutant emission impacts associated with the oil and gas replacement program.^{1/} The paper focuses on the industrial and utility sectors, identifying air pollutant emissions from these sectors under the oil and gas replacement program as well as the entire President's Program. Analyses of the energy and economic impacts of the National Energy Plan (NEP) policies on these sectors are contained in a separate document.^{2/} The environmental analysis relies heavily on the results described in this earlier document. In addition to presentation of analytical results, this paper details the methodology used to calculate the air pollutant emission levels.

A. Program Description

The oil and gas replacement program requires, with certain exceptions, that all new utility plants and large industrial boilers (greater than 10 MW) must burn coal or other fuels rather than oil and gas. Authority is also granted to require use of coal by other new industrial facilities (non-boilers). In addition to these regulatory provisions, the program includes taxes on the use of oil and gas by utilities and large industrial facilities and refunds (or investment tax credits for industry) for investments in non-oil and gas facilities or retirements of existing oil and gas facilities.

B. Environmental Protection Measures

The NEP also contains several provisions designed to mitigate potential adverse environmental effects from the expanded use of coal. Specifically, the National Energy

^{1/} Also referred to as the Coal Program.

^{2/} "Replacing Oil and Gas with Coal and Other Fuels in the Industrial and Utility Sectors," Executive Office of the President, Energy Policy and Planning, June 2, 1977.

Plan calls for the use of best available control technology (BACT)^{1/} on all new facilities larger than 25 MW.

In addition to BACT, the President has announced several policies specifically designed to minimize adverse environmental impacts from increased coal utilization. The policies most closely related to mitigation of air impacts are the Clean Air Act Amendments supported by the Administration. The key provisions of these amendments are listed below:

- o the requirement for a policy for prevention of significant deterioration,
- o disallowance of credit for tall stacks to meet air quality requirements,
- o establishment of non-compliance penalties for sources which do not meet compliance dates or do not operate and maintain pollution control equipment adequately, and
- o continuation of the current EPA emissions offset policy in non-attainment areas.

The National Energy Plan also recognizes that it may be necessary to continue use of oil and gas in areas where serious air pollution problems currently exist by allowing exemptions and exceptions on the basis of environmental constraints. As a part of the NEP the President called for a Committee to study:

- (1) the health effects of increased coal production and use, and
- (2) the environmental constraints on coal mining and on the construction of new coal-burning facilities.

The Committee is scheduled to report its findings by October 1977.

^{1/} See Section II for assumptions about BACT.

C. Summary of Findings

The major air pollutants of concern when burning coal rather than oil or gas are sulfur dioxide (SO₂) particulates (TSP), and nitrogen oxide (NO_x). Figure 1 compares the national emissions of industries and utilities for each of these pollutants under several scenarios:

- o the 1975 actual emissions
- o a 1985 baseline which would occur with no energy plan
- o an estimate of the impacts of the oil and gas replacement (coal) program alone in 1985, and
- o an estimate of the impact of the entire President's Program in 1985.

The incremental effects of the coal program and the President's program are identified through comparison with the 1985 baseline which represents a forecast based on current trends with no NEP. These emission levels are combined totals for industrial and utility sources. The 1975 emission levels provide a means for comparison with current emissions.

All of the 1985 cases assume the use of BACT^{1/} on new sources (i.e., as required by the Clean Air Act Amendments) and full compliance with emission requirements.^{2/} If the 1985 baseline did not include the BACT provision, the comparative emission impacts of the NEP would appear even less significant since BACT contributes to reductions in the 1985 baseline.

^{1/} BACT is applied to all new utilities which begin operation after 1984 and to new industrial sources, after 1979.

^{2/} The emissions impacts assuming New Source Performance Standard (NSPS) control are presented in Appendix 2.

FIGURE 1
NATIONAL AIR POLLUTANT EMISSIONS FROM INDUSTRIES AND UTILITIES

^{1/} The 1985 estimates assume full compliance with applicable emission limitations and implementation of best available control technology (BACT) provisions of Clean Air Act Amendments.

INDUSTRY
 UTILITY

Major Findings

There are four major findings from the air pollution impact analysis:

- o The oil and gas replacement program causes small increases in national emissions over the 1985 baseline. (Figure 1)^{1/}
- o The national emissions impact of total President's program is not significantly different than the 1985 baseline. (Figure 1)^{1/}
- o The relative air pollutant emissions contribution of the industrial and utility sectors are very different. Under the NEP emissions in the utility sector decline while emissions increase in the industrial sector.
- o The regional emissions impacts are insignificant in all regions except Region VI.

These findings are discussed in greater detail below.

Moderate Increases in National Emissions from the Oil and Gas Replacement Program

As shown in Table 1, the national emissions of SO₂ and NO_x are all predicted to increase above the 1985 baseline^{2/} when the oil and gas replacement program is considered alone.^{2/} Total national emissions of TSP from these sectors is not changed by the program. The majority of the SO₂ increase is attributable to greater industrial use of coal and reflects the fact that even under the BACT assumption, emissions when burning coal are slightly larger than emissions when burning oil and much larger than when burning gas.

Table 1. Percentage Increases in Emissions Over the 1985 Baseline

	<u>Coal Program</u>	<u>President's Program</u>
SO ₂	5%	-3%
TSP	0%	-2%
NO _x	5%	2%

1/ See Tables 4, 5 and 6.

2/ Since the different policies in the NEP are all interdependent, it is difficult to isolate the effects of individual policies in this manner.

Total increases for SO₂ and NO_x are approximately 5 percent above the 1985 baseline. If the 1985 baseline assumes NSPS rather than BACT emission controls, SO₂ emissions would increase 3 percent and TSP emissions would decrease 3 percent.

Minimal Impact of the Total President's Program

Table 1 shows that the emissions of TSP, NO_x and SO₂ predicted to occur under the President's Program are very close to the 1985 baseline levels: TSP, 2 percent decrease; SO₂, 3 percent decrease; and NO_x, 2 percent increase. While the oil and gas replacement program contributes to increased emissions, the load management and conservation policies in the remainder of the Plan cause a decrease in total fuel consumption and therefore a reduction in combustion related emissions. These reductions effectively balance the increases from the oil and gas replacement program at the national level.^{1/} If the NEP emissions are compared to a NSPS baseline in 1985 that does not include the impacts of BACT, the impacts are as follows: TSP, 2 percent decrease;^{2/} SO₂, 5 percent decrease; and NO_x, 1 percent increase.^{2/}

The only significant national emission increases projected to occur between 1975 and 1985 are projected for NO_x. However, this increase is common to all the 1985 cases^x, not just the NEP scenario. NO_x emission increases are not related to the use of different fuels but reflect the lack of highly effective control technology. Since increases in fuel combustion are projected in the baseline, NO_x emission increases are projected for 1985 both with and without the NEP.

Relative Emissions Contribution of Industries and Utilities

The NEP affects both utility and industrial fuel use; however, the effects in these two sectors are very different. Utilities are already planning to burn coal rather than oil and gas in virtually all new baseload units except for those currently under construction. While the coal program would tend to increase coal use (with related oil and gas savings),

^{1/} As is discussed later, this balance is not always evident at the regional level.

^{2/} See Appendix 1 for full presentation of results under this assumption.

conservation measures would reduce coal consumption. The net effect is that coal use by utilities in 1985 is projected to be approximately the same both with and without the President's Program but oil and gas use by utilities would be reduced substantially. Therefore, the following percentage reductions in emissions from utilities in 1985 occur under the President's Plan as compared to the 1985 baseline: Particulates, 8 percent; SO₂, 9 percent; and NO_x, 9 percent.

The effect of the NEP on the industrial sector is much more pronounced. By 1985 industrial facilities are projected to consume almost 200 million more tons of coal per year than they would without the Plan. Without the Plan it is estimated that industry would continue to burn oil and gas, chiefly because fuel costs for industry are not as large a fraction of operating expenses as they are for utilities and because oil and gas is less troublesome to handle at an industrial site than is coal. However, significant shifting from gas and oil to coal is expected under the Plan. As a result of this increase in coal use, emissions from the industrial sector will increase in 1985.

The percentage increases in particulate emissions are insignificant under the NEP. Industrial processes rather than fuel combustion are the major contributors of industrial TSP emissions. This analysis has focused on changes in TSP emission from industrial fuel combustion only since these are the activities in the industrial sector which are impacted by the NEP policies. SO₂ emissions from the industrial sector increase by 19 percent in the oil and gas replacement program and 8 percent under the President's Program when compared to the 1985 baseline. Comparable NO_x emissions increases are 12 percent and 17 percent.

Regional Trends

In general, regional emissions estimates reflect the major trends discussed above. The results are summarized below for each pollutant under the oil and gas replacement program and under the entire President's Program. Tables 9, 10 and 11 in Section III provide the background material for this summary. (See Figure 2, Federal Regions)

Oil and Gas Replacement Program

Emissions of TSP increase in four regions (V, VI, VII, and IX) under the oil and gas replacement program as

Figure 2 Federal Regions

compared to the 1985 baseline. The increases range from 1 percent (Region V) to 3 percent (Region IX). TSP emissions either decrease or are unchanged in other Regions.

SO_x emissions increase in every region under the oil and gas replacement program. The range of increase over the 1985 baseline is from 2 percent (Region I) to 31 percent (Region VI). Most of the regional emissions increases are about 3 to 4 percent.

NO_x emissions also increase in every Region. This increase ranges from 2 percent (Regions I and II) to 12 percent (Regions VI and IX).

Total President's Plan

Particulate emissions decrease or remain unchanged in every Region except Region IX (where there is a 1 percent increase) under the President's Program as compared to the 1985 baseline. This decrease ranges from 1 percent (Regions IV, VI, and VII) to 4 percent (Region I).

Only three Regions show increases in SO_x emissions under the President's Program: Region VI, 30 percent; Region VIII, 6 percent; and Region X, 12 percent. All other regions exhibit decreases ranging from 1 percent (Region III) to 16 percent (Region I).

NO_x emissions also increase in three regions under the President's Program: Region VI, 22 percent; Region VIII, 9 percent; and Region X, 38 percent. Decreases in NO_x emissions range from 2 percent (Regions I, III, and V) to 10 percent (Region II).

If regional impacts of the oil and gas replacement program and the NEP are compared to a 1985 baseline which does not include BACT, comparative impacts are smaller. (See Appendix 1 for regional results under this assumption.)

Qualifications and Assumptions

These national and regional emissions do not indicate how the coal program is expected to affect attainment of air quality standards in specific areas of the country. There are some areas where additional use of coal could impair attainment of health standards. However, the NEP was developed assuming that increased coal use would not occur, and should not be allowed, in some areas due to environmental constraints.

Assumptions which are important to interpretation of the analysis include:

- (1) all existing facilities will comply with applicable emission limitations in the state implementation plans (SIP) by 1985. The validity of this assumption depends on effective enforcement effort by both the State and the Federal Governments.
- (2) BACT controls for SO₂ will require scrubbers on large boilers (above 25 MW). Scrubbers are assumed to have 90 percent effective SO₂ removal and to be available 90 percent of the time (i.e., 80 percent efficient).
- (3) a revised new source performance standard of 1.5 lbs SO₂/MMBtu covering boilers between 10 MW and 25 MW will be promulgated.
- (4) BACT will apply to new utilities beginning operation in 1984 and industry beginning operation in 1979.
- (5) the NEP will be implemented as proposed. Under the entire energy plan, the conservation measures and the programs which free up gas for use in the residential and industrial sectors are particularly important for producing the offsetting emission reductions under the entire plan.

Analysis of the effects of the oil and gas replacement program and of the entire NEP in 1990 will be issued in a supplementary document. Most of the effects of the coal conversion program in the industrial sector are expected to occur by 1985. However, both the oil and gas replacement program and the conservation measures are expected to have a larger impact on the utility sector in 1990 than in 1985.

The remaining sections of this paper discuss the methodology used to calculate emissions and present more detailed air pollutant emission results.

II. DESCRIPTION OF METHODOLOGY

There are four basic steps to the methodology for calculating emission impacts of SO_2 , TSP, and NO_x :

- (1) Estimate the type and quantity of fuel consumed in each scenario (e.g., 1975, 1985 baseline, President's Program, and Oil and Gas Replacement Program) by certain categories of industrial and utility users.
- (2) Construct different cases which represent a range of potential emission control assumptions.
- (3) Calculate the emission factors for SO_2 , TSP, and NO_x which are applicable to new and existing facilities under these cases, and
- (4) Determine national and regional emission levels.

The approach in each sector differs somewhat. However, Appendix 2 provides a detailed accounting of the methodology used in the industrial sector and Appendix 3 describes the methodology used in the utility sector.

A. Energy Baseline

Construction of the energy baseline was accomplished primarily through the FEA Project Independence (PIES) model.^{1/} The first step in formulating the baseline was to forecast the fuel type (oil, gas, coal, other) and quantity of fuel used in each sector. This is a function of fuel prices and other economic factors input to PIES as well as the impacts of specific provisions of the NEP such as conversions to coal and load management. Table 2 provides several different energy scenarios for the industrial and utility sectors:

- o actual 1975
- o 1985 baseline without the NEP
- o 1985 with the oil and gas replacement program alone
- o 1985 with the entire President's Program.

These energy scenarios are used consistently throughout the analysis.

After obtaining the breakout by fuel type and quantity in each sector it was necessary to apportion these totals to new as opposed to existing units. It was further necessary to determine what percentage of fuel is^{2/} used in large installations (greater than 25 MW) and small^{3/} installations (from 10-25 MW, industrial only). All of these refinements are necessary because different emission regulations may apply to small vs. large, new vs. existing units.^{3/}

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- 1/ For a detailed explanation of the energy impact numbers see Appendices A and B to "Replacing Oil and Gas with Coal and other Fuels in the Industrial and Utility Sectors." This PIES baseline was adjusted for the utility sector as described in Appendix 3 of this paper.
 - 2/ Very small installations (less than 10 MW) were not considered in this analysis.
 - 3/ This methodology is explained in detail in a separate report "The Replacement of Oil and Gas with Coal and Other Fuels in The Industrial and Utility Sectors" Appendix A.

TABLE 2: Energy Used for Fuel Combustion
in the Industrial and Utility
Sectors

INDUSTRIAL SECTOR^{1/}

	Oil (oil equivalents MMB/D)	Gas	Coal (10 ⁶ tons)	Increase in Coal Use over 1985 Baseline: (10 ⁶ tons)
1975	1.4	3.8	63	
1985 Baseline	3.8	3.9	101	
1985 Coal Program (Savings over 1985 baseline)	(0.9)	(1.3)	300	199
1985 President's Program ^{2/}	1.6	3.5	278	177

UTILITY SECTOR

	Oil (oil equivalents MMB/D)	Gas	Coal (10 ⁶ tons)	Increase in Coal Use over 1985 Baseline: (10 ⁶ tons)
1975	1.3	1.6	404	
1985 Baseline ^{3/}	2.3	0.9	763	
1985 Coal Program (Savings over 1985 baseline)	(0.7)	(0.4)	860	97
1985 President's Program ^{2/}	1.5 ^{4/}	0.5	779	16

^{1/} This does not include oil and gas feedstock and metallurgical coal.

^{2/} The President's Program includes the effects of the coal program and conservation policies.

^{3/} PIES run A148524C.

^{4/} PIES run A158569C. (There was a technical error in the PIES specifications for this run. The effect of correcting this error is estimated to be that oil consumption would be 1.2 MMB/D)

The most important information from the standpoint of emissions impacts is where the increased coal is used. As shown in Table 2, the majority of increased coal use in 1985 occurs in the industrial sector. When the increase in industrial coal from the coal program is combined with the increase in the baseline between 1976 and 1985, the additional demand is apportioned as follows:

- o new energy facilities - 81 percent
- o existing facilities with capability to burn coal - 9 percent
- o accelerated replacement of existing oil-and-gas-fired facilities - 10 percent

Almost all of the increased coal use in the utility sector occurs in replacement or new coal-fired facilities both of which are subject to new source emission limitations. As a result over 90 percent of the increased coal use between 1976 and 1985 is subject to either new source performance standards (NSPS) or best available control technology (BACT).^{1/}

B. Emission Control Assumptions

There is some uncertainty about emission control requirements that will apply to new and replacement facilities converting to coal in the 1985 time frame. The uncertainty can be categorized into three areas:

- o status of the proposed Clean Air Act Amendments
- o definition of BACT, and
- o emission control requirements for small facilities.

Several cases were developed for this analysis to represent differing assumptions about each of these variables. These cases are summarized on Table 3. Different emission control requirements apply to new vs. existing sources.

^{1/} Assuming that a revised new source performance standard is promulgated for facilities between 10MW to 25 MW. In any case, 90 percent of the facilities would undergo new source review.

TABLE 3: Range of Emission Control Assumptions

	<u>NEW SOURCES</u>		<u>EXISTING SOURCES</u>
	<u>Large</u> ^{1/}	<u>Small</u> ^{2/}	
Case 1: <u>SO₂</u>	BACT(90%) ^{3/}	1.5 lb/MMBTU ^{4/}	SIP
<u>TSP</u>	BACT(0.01 lb/MMBTU)	0.03 lb/MMBTU	SIP
<u>NOx</u>	NSPS	*	*
Case 2: <u>SO₂</u>	BACT(80%) ^{5/}	1.5 lb/MMBTU	SIP
<u>TSP</u>	BACT(0.05 lb/MMBTU)	0.05 lb/MMBTU	SIP
<u>NOx</u>	NSPS	*	*
Case 3: <u>SO₂</u>	BACT(80%)	SIP	SIP
<u>TSP</u>	BACT(0.05 lb/MMBTU)	SIP	SIP
<u>NOx</u>	NSPS	*	*
Case 4: ^{6/} <u>SO₂</u>	NSPS	SIP	SIP
<u>TSP</u>	NSPS	SIP	SIP
<u>NOx</u>	NSPS	*	*

* Emission factors for these sources of NOx were obtained from AP-42, "Compilation of Air Pollutant Emission Factors," and reflect uncontrolled emissions.

^{1/} Utilities and industrial boilers greater than 25 MW (250 MMBtu/D).

^{2/} Boilers between 10 MW and 25 MW.

^{3/} This assumes 90 percent efficiency and 100 percent reliability from scrubber equipment as well as coal cleaning.

^{4/} This assumes a revision of current NSPS to cover small boilers, which are not now regulated by current NSPS.

^{5/} This assumes 90 percent efficiency and 90 percent reliability from scrubber equipment as well as coal cleaning.

^{6/} This case assumes no change in the current Clean Air Act.

Three of the four cases used in this analysis are described below. Cases 1 and 4 provide the bounds on the ranges of emission estimates because of the assumptions about EACT. Case 2 was chosen as the most probable case so the assumptions implicit in Case 2 are described in greatest detail.

Case 1 represents the most stringent environmental requirements. The BACT level for SO_2 called for removal of 90 percent of the sulfur from locally available coals. The TSP controls assume a 99.8 percent reduction from BACT for large sources. For small sources (10 to 25 MW), revised NSPS^{1/} of 1.5 pounds per MMBtu for SO_2 and 0.03 pounds per MMBtu for TSP were assumed. All existing sources were assumed to meet SIP. NO_x emissions were assumed to meet NSPS.

Case 4 represents the least stringent environmental control requirements. Current NSPS for SO_2 , TSP, and NO_x were assumed to apply to all existing sources greater than 25 MW capacity. All existing sources and smaller facilities (10 to 25 MW) are assumed to meet SIP for TSP, SO_2 and NO_x .

The results of Case 2 are presented throughout this paper. Case 2 was considered the most realistic case for several reasons. The BACT level for SO_2 reflects 80 percent removal of SO_2 from locally available coal. This assumes 90 percent efficiency and 90 percent reliability from SO_2 scrubbers which provides for some possible deterioration of efficiency or unavailability.

The TSP control level for Case 2 is 99 percent which can be met by an SO_2 scrubber or with an electrostatic precipitator or baghouse where scrubbers are not required. This case also includes revised NSPS for small new sources. These levels of control on new and modified sources are reasonable based on activities already underway in EPA to revise current NSPS.

The impacts estimated under the assumptions in Cases 1 and 4 described above are used to provide some insight into the sensitivity of the results. Case 4 estimates are included in Appendix 1 at a comparable level of detail to the Case 2 impacts.

^{1/} New source performance standards.

C. Emission Factors

The emission control assumptions cases described above were structured to determine what emission factors would be applicable in the analysis. Emission factors are keyed to fuel use (oil, gas, and coal) and the level of environmental control required.

Emissions from new sources are regulated at the Federal level (NSPS or BACT). However, variability in emissions of SO₂ when using coal under BACT will occur because of the varying sulfur content of the coal burned. Therefore, it is necessary to have a different set of emission factors for each region which are based on the coal used and the 80 percent BACT control requirement.

Emissions from existing sources must meet SIP requirements. These requirements vary from state-to-state and often from county-to-county. In order to calculate regional emissions for industries, these SIP requirements were weighted to reflect the percentage of fuel of a certain type which had to conform to each requirement. These weighted factors were then aggregated to the regional level.

D. Regional Emission Levels

In general, emission levels are a function of fuel mix and emission factors for each type of fuel. The energy baseline and the NEP scenarios must be presented in terms of the mix of oil, gas, and coal in each region. The percentage of each of these fuels burned in new versus existing and small versus large sources also must be identified in every region. Then the emission factors denoted in Step 3 above are applied to each of these classes of use to calculate total emissions on each fuel. The total of emissions on all fuels consumed by industries added to a similar total for utilities in each region provides the impact numbers presented in this document.

E. Non-Compliance

A key assumption in all of the 1985 energy scenarios is that there will be full compliance with the Clean Air Act, either current or as amended. This assumption is particularly

important with respect to TSP where the current rate of non-compliance is very high. If this assumption proves to be optimistic then the 1985 TSP emission levels would not show the significant improvements over the 1975 levels illustrated in Figure 1.

It should also be noted that the proposed amendments to the Clean Air Act, which are supported by the Administration, call for non-compliance penalties. The probable enactment of the Clean Air Act amendments including such penalties reinforces the full compliance assumption.

F. Limits to the Analysis

There are several important factors which were not included in this analysis due to time constraints, lack of data, and other considerations. It is necessary to recognize these factors so that the results which are presented may be put into an appropriate context. Four major considerations are listed below:

- o local, site-specific impacts
- o new national ambient air quality standards (NAAQS)
- o environmental limits to coal supply and use, and
- o institutional factors.

These concerns include areas where the program impacts are not fully identified as well as constraints which may limit the full potential of the program.

Local impacts: The national and regional emission estimates provide little insight into local or site-specific problems. Such problems must be identified on a case-by-case basis. No analysis of the potential for and severity of site specific problems has been done to date. However, over 90 percent of the increased coal use is in new facilities subject to NSPS or BACT and significant deterioration and non-attainment policies can be used to assure the protection of public health.

New NAAQS: In the time frame between 1977 and 1985 it is possible that additional new ambient air quality standards may be promulgated for sulfates, short term NO_x , and fine particulates. This analysis only estimates impacts for particulates, SO_2 and NO_x . The estimation of constraints to

coal use due to the additional pollutants listed above is not possible because of the uncertainty concerning the timing, level, and emission control implications of future ambient air quality standards. Similarly, the effects of this program on CO₂ levels has not been addressed.

Environmental Limits to Coal Use. The primary constraints on increased coal use are expected to arise from non-attainment and air quality maintenance considerations. This analysis accounts for such constraints in a rough manner by approximating the new fuel use that might be eligible for exemptions or the existing fuel use which might not be capable of converting to coal due to environmental constraints. Further refinement at the site-specific level is necessary because air quality problems from coal combustion, particularly SO₂ and TSP, are very site-specific problems.

Institutional Factors: Delays may be experienced in the implementation of the oil and gas replacement program. These delays may occur as a result of legislative delays, long lead times for siting of facilities, or time requirements for purchase and installation of equipment. The effect of these delays would be to spread the conversions over a longer time period therefore reducing emissions impacts in 1985. In addition, delays in the implementation of BACT requirements could occur past the 1984 and 1979 dates assumed for utilities and industries in this analysis. The impact of a delay in BACT would be an increase in 1985 emission levels.

III. FINDINGS

This section presents the air pollutant emission impacts of the coal program and the entire President's Program.

The following estimates are provided for each energy scenario:

- o national emissions from the industrial and utility sectors for TSP, SO₂ and NO_x
- o regional emissions of TSP, SO₂ and NO_x, and
- o an indication of sensitivity of the predicted impacts.

Before presenting the results of the analyses, it is useful to have some perspective on the proportion of total emissions which is represented by the industrial and utility categories in this analysis. Table 4 presents total national emissions in 1975 as a function of source categories. The importance of industrial and utility sources to the total emissions is heavily dependent upon the specific pollutant. In the case of TSP, combustion sources represent 37 percent of the total emissions, whereas for SO₂ they represent 80 percent and for NO_x approximately 50 percent. It is important to note that this analysis is confined to the effect of NEP policies on the emissions contribution from only the industrial and utility sectors.

One additional point of clarification is necessary. All emissions from industrial sources are included in this analysis (e.g., total 1975 TSP emissions for the industrial sector of 11.2 MT/year consist of 2.5 MT/year from industrial fuel combustion and 8.7 MT/year from industrial process sources as shown in Table 4). However, only those industrial emissions due to fuel combustion (boiler and non-boiler) are affected by the oil and gas replacement program. The process emissions are assumed to remain the same in each of the three 1985 scenarios.

Although it is not included in this analysis there is an important secondary impact of the oil and gas replacement program. The shifts from gas to coal and the reduction in gas use due to the gas pricing policy free up gas for use in the residential/commercial sector. The replacement of oil with gas in the residential/commercial sector will result in

TABLE 4: Nationwide Emission Estimates for all Source Categories, 1975 Preliminary^{1/}

(10 ⁶ tons/year)						
Source Category	Particulates ^{2/}	%	SO ₂	%	NO _x	%
<u>Transportation</u>	1.3	(7)	0.8	(2)	10.7	(44)
<u>Stationary Fuel Combustion</u>						
Electric Utilities	3.5		21.0		6.8	
Industrial	2.5		5.0		4.9	
Other	.6		0.3		0.7	
<u>Total</u>	<u>6.6</u>	(37)	<u>26.3</u>	(80)	<u>12.4</u>	(51)
<u>Industrial Processes</u>	8.7	(48)	5.7	(17)	0.7	(3)
<u>Solid Waste</u>	0.6	(3)	0.1	(—)	0.2	(1)
<u>Miscellaneous</u>	0.8	(4)	0.1	(—)	0.2	(1)
<u>Total</u>	<u>18.0</u>	(99)	<u>32.9</u>	(99)	<u>24.2</u>	(99)

1/ Source: EPA National Emission Data System (NEDS). This is preliminary data and has been updated by EPA at other places in this analysis.

2/ TSP concentrations can be significantly affected by natural, agricultural, and other sources of fugitive dust. These sources are not included in this total.

a decrease in emissions from this sector. These emissions benefits are not considered in this analysis.

A. National Emission levels

The national emission levels of TSP, SO₂, and NO_x estimated for each of the energy scenarios are contained on Tables 5, 6, and 7. The discussions below consider each pollutant individually.

1. Particulates

As shown in Table 5, the oil and gas replacement program causes a negligible increase in TSP emissions in 1985 and a 1 percent increase in the industrial sector. The impact of the entire President's program is a slight decrease in emissions of TSP; 2 percent as compared to the 1985 baseline. This decrease occurs because of conservation effects of the total program which cause an 8 percent decrease in utility emissions of TSP. The significant reductions in the 1985 baseline over 1975 reflect the assumption of compliance in 1985 as compared to the high levels of non-compliance in 1975.

2. Sulfur Dioxide

Table 6 presents the national emissions of SO₂ from industries and utilities. The most notable impacts occur in the industrial sector where emissions increase by 19 percent over the 1985 baseline in the oil and gas replacement program, and by 8 percent in the total President's Program. The emissions reductions in the utility sector are attributable to reduced fuel combustion because of conservation and load management. The reduction in SO₂ emissions from utilities (9 percent over the 1985 baseline) causes an overall decrease of 3 percent in SO₂ emissions under the President's Program.

TABLE 5: National Emissions of TSP From Industries and Utilities

<u>Source</u>	1975	1985	1985	% ^{1/}	1985	% ^{1/}
	Actual (10 ⁶ tons)	Baseline (10 ⁶ tons)	Coal Program (10 ⁶ tons)		President's Program (10 ⁶ tons)	
Industry	11.2	11.2	11.3	(+1%)	11.2	(0%)
Utility	3.1	1.3	1.2	(-8%)	1.2	(-8%)
Total	14.3	12.5	12.5	(0%)	12.3	(-2%)

TABLE 6: National Emissions of SO₂ From Industries and Utilities

<u>Source</u>	1975	1985	1985	% ^{1/}	1985	% ^{1/}
	Actual (10 ⁶ tons)	Baseline (10 ⁶ tons)	Coal Program (10 ⁶ tons)		President's Program (10 ⁶ tons)	
Industry	10.8	10.8	12.8	(+19%)	11.7	(+8%)
Utility	18.6	20.2	19.9	(-1%)	18.3	(-9%)
Total	29.4	31.1	32.7	(+5%)	30.1	(-3%)

^{1/} % change from 1985 Baseline

3. Nitrogen Oxides

As shown in Table 7, total national emissions of NO_x will increase about 2 percent due to the President's Program as compared to the 1985 baseline. This slight overall increase is the result of increases in the industrial sector (17 percent) balanced by decreases in the utility sector (9 percent). Table 7 also shows that significant increases of NO_x emissions are predicted in 1985 as compared to the actual 1975 levels regardless of whether or not the NEP is implemented. This increase in NO_x emission is caused by general growth, and the lack of highly effective control technology rather than alternative fuel use.

4. Sensitivity of Results

Table 8 provides estimates of the sensitivity of the analytical results. The totals represent the range of emissions impacts calculated for all four of the cases described in Table 3. (Case 1 provides the lower bound and Case 4 the upper bound). As Table 8 shows, the range of estimates for particulates is very small. The range for SO₂ is considerably greater especially in the industrial sector.

TABLE 7: National Emissions of NO_x From Industries and Utilities

<u>Source</u>	1975	1985	1985	<u>1/</u>	1985	<u>1/</u>
	Actual (10 ⁶ tons)	Baseline (10 ⁶ tons)	Coal Program (10 ⁶ tons)		President's Program (10 ⁶ tons)	
Industry	6.0	6.6	7.4	(12%)	7.7	(17%)
Utility	6.6	9.0	9.0	(0%)	8.2	(-9%)
Total	12.6	15.6	16.4	(5%)	15.9	(2%)

1/ percent change from the 1985 baseline.

TABLE 8: Range of National Emissions Predicted for Industries and Utilities ^{1/}(10⁶ Tons)

PARTICULATES

<u>Scenario</u>	<u>Industry</u> ^{2/}	<u>Utility</u>
1975 Actual	11.2	3.1
1985 Baseline	11.2-11.4	1.2-1.2
1985 Coal Program	11.2-11.8	1.2-1.3
1985 President's Program	11.1-11.7	1.2-1.2

SO₂

1975 Actual	10.8	18.6
1985 Baseline	10.7-12.4	19.7-20.2
1985 Coal Program	12.3-16.6	19.3-20.2
1985 President's Program	11.3-15.9	17.8-18.3

^{1/} This table presents the results of the four cases described in Table 3. Case 1 (stringent BACT) results represent the lower bound and Case 4 (current NSPS) results, the upper bound. Only one case was considered for NO_x.

^{2/} The results for Case 3 are not shown in the above table. Case 3 assumes that no revised NSPS for small boilers is promulgated and that small boilers (less than 25 MW) are subject to SIP. Utility emissions do not vary under this assumption. The results from Case 3 for industry are as follows:

	<u>SO₂</u>	<u>TSP</u>
1985 Baseline	11.2	11.3
1985 Coal Program	14.8	11.6
1985 President's Program	14.0	11.8

Only one case was analyzed for NO_x.

This range reflects the variation between application of NSPS and BACT. Even though the case presented in the analysis (Tables 5, 6, and 7) is not the most stringent BACT case, the impacts predicted are very close to the low end of the range.

B. Regional Emission Levels

Regional emissions of particulates, SO₂, and NO_x were calculated for both industries and utilities in each of the energy scenarios. The results are presented on Tables 9, 10, and 11. These estimates should be considered as interim projections because work is still underway to refine them further. Special care should be taken in interpreting small differences when the totals are small since PIES does not have the capability to accurately site power plants. The discussion below addresses each pollutant separately.

The most significant regional impacts occur in Region VI in the form of increased SO₂ emissions. These increases occur for several reasons, all of which are related to the current reliance of this region on natural gas. First, the 1985 baseline SO₂ emissions are over two times as large as the 1975 levels for SO₂. This occurs because of increased utility use of coal between 1975 and 1985 in the baseline. While utility emissions do not increase significantly in Region VI under the NEP, compared to the 1985 baseline, industry emissions approximately double due to increased coal use. As a result, the President's Program shows a 30 percent increase over the 1985 baseline in Region VI.

Emissions of NO_x also increase in Region VI under the coal program (12 percent) and the President's Program (22 percent). The increase under the coal program is due to replacement of oil with coal which has higher NO_x emissions. Under the President's Program, conservation measures "free up" some gas which replaces oil in Region VI. Emissions of NO_x on gas are higher than those from oil, thus NO_x emissions increase further with the incremental use of gas under the President's Program.

1. Particulates

As shown in Table 9, the regional emission trends for particulates conform closely to the national trends in that:

TABLE 9: Projected Particulate Emissions From Utilities and Industries by Region (10³ Tons)

Federal Region	1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
I Utility	40	30	0	30	-10	20
Industry	210	210	0	210	0	210
Total	250	240	0	240	-10	230
II Utility	120	40	0	40	0	40
Industry	550	550	0	550	0	550
Total	670	590	0	590	0	590
III Utility	500	100	0	100	0	100
Industry	1280	1280	0	1280	0	1280
Total	1790	1380	0	1380	0	1380
IV Utility	1050	270	-20	250	-30	240
Industry	2490	2490	10	2500	-10	2480
Total	3540	2760	-10	2750	-40	2720
V Utility	990	400	0	400	-10	390
Industry	3040	3040	20	3060	-50	2990
Total	4030	3440	20	3460	-60	3380
VI Utility	130	170	-20	150	-30	140
Industry	1210	1210	30	1240	20	1230
Total	1340	1380	10	1390	-10	1370

TABLE 9: Projected Particulate Emissions From Utilities and Industries by Region (10^3 Tons) (Cont)

Federal Region	1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
VII Utility	190	110	0	110	-10	100
Industry	1040	1040	10	1050	0	1040
Total	1230	1150	10	1160	-10	1140
VIII Utility	80	90	-10	80	-10	80
Industry	400	400	10	410	0	400
Total	480	490	0	490	-10	480
IX Utility	30	30	10	40	0	30
Industry	660	660	10	670	10	670
Total	690	690	20	710	10	700
X Utility	0	10	0	10	0	10
Industry	330	330	0	330	-10	320
Total	330	340	0	340	-10	330
National						
Utility	3140	1250	-40	1210	-100	1150
Industry	11200	11210	90	11300	-40	11170
Total	14340	12460	50	12510	-140	12320

1) there is no significant impact from the President's Program; and 2) the Coal Program causes small increases which are usually offset by the entire NEP. This does not reflect any impact of the NEP but rather the non-compliance in 1975 and assumed compliance in 1985.

2. Sulfur Dioxide

Table 10 shows that regional emissions of SO₂ would increase slightly under the oil and gas replacement program but would decrease again under the total President's Program. The most significant increases in emissions of SO₂ occur in Region VI and are 30 percent over the 1985 baseline under the Coal Program and the President's Program. These increases occur for reasons outlined above. Regions IV and V both show decreases when comparing the President's Program to the 1985 baseline. In general, regional utility emissions of SO₂ are less under the President's Program than for the 1985 baseline. In all but three regions (VI, VII, VIII) this decline offsets industrial increases in SO₂ emissions. It should be noted that increases in SO₂ emissions occur in most regions (I, IV, VI, VII, VIII, IX, X) in the 1985 baseline as compared to 1975. This occurs because of increased coal use by utilities in these areas.

3. Nitrogen Oxides

Table 11 presents the regional estimates of NO_x emissions for each energy scenario. It should be recognized that these results represent NSPS assumptions rather than BACT, since BACT for NO_x has not been assumed in this analysis.

Every region shows an increase in NO_x emissions from the 1975 levels; however, this result shows up in the 1985 baseline as well as the NEP cases. This impact is explained by the fact that highly effective NO_x controls are not currently available so growth in sources translates directly to growth in emissions.

Region VI experiences the most substantial increases in NO_x emissions: 22 percent in the President's Program over the 1985 baseline. In fact, Regions VI and X are the only regions in which NO_x emissions increase under the President's Program as compared to the 1985 baseline.

NO_x emissions from the utility sector decrease in almost every region due to conservation and reduced fuel use. The regional industrial emissions increase in the Coal Program and either remain the same or decrease under the President's Program. Region VI is the most important exception where industrial NO_x emissions increase substantially (30%) under the President's Program as compared to the Coal Program for reasons described in a previous section.

TABLE 10: Projected SO₂ Emissions from Utilities and Industries by Region (10³ Tons)

Federal Region	1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
I	Utility 220 Industry 230 Total 450	400 230 630	-10 20 10	390 250 640	-50 -50 -100	350 180 530
II	Utility 780 Industry 590 Total 1370	760 600 1360	-10 50 40	750 650 1400	-130 50 -80	630 650 1280
31 III	Utility 3120 Industry 1500 Total 4620	2820 1510 4330	-30 160 130	2790 1670 4460	-170 110 -60	2650 1620 4270
IV	Utility 5010 Industry 2060 Total 7070	5130 2060 7190	-80 260 180	5050 2320 7370	-740 -50 -790	4390 2010 6400
V	Utility 7550 Industry 3730 Total 11280	6450 3740 10190	-240 460 220	6210 4200 10410	-350 -230 -580	6100 3510 9610
VI	Utility 160 Industry 690 Total 850	1920 690 2610	80 730 810	2000 1420 3420	0 790 790	1920 1480 3400

TABLE 10: Projected SO₂ Emissions from Utilities and Industries by Region (10³ Tons) (Cont)

Federal Region	1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
VII Utility	1300	1800	-10	1790	-300	1500
Industry	660	660	90	750	80	740
Total	1960	2460	80	2540	-220	2240
VIII Utility	240	400	0	400	0	400
Industry	230	230	60	290	40	270
Total	470	630	60	690	40	670
IX Utility	180	420	-10	410	-130	290
Industry	980	990	70	1060	100	1090
Total	1160	1410	60	1470	-30	1380
X Utility	40	110	0	110	0	110
Industry	140	140	60	200	30	170
Total	180	250	60	310	30	280
National						
Utility	18600	20210	-310	19900	-1870	18340
Industry	10810	10850	1960	12810	870	11720
Total	29410	31060	1650	32710	-1000	30060

TABLE 11: Projected NO_x Emissions From Utilities and Industries by Region (10³ Tons)

<u>Federal Region</u>	<u>1975 Actual</u>	<u>1985 Base</u>	<u>Change: Coal Program (from 1985 base)</u>	<u>1985 Coal Program</u>	<u>Change: President's Program (from 1985 base)</u>	<u>1985 President's Program</u>
I Utility	200	210	0	210	-30	180
Industry	230	250	10	260	20	270
Total	430	460	10	470	-10	450
II Utility	650	720	-10	710	-160	560
Industry	550	600	30	630	30	630
Total	1200	1320	20	1340	-130	1190
III Utility	1090	1280	-10	1270	-80	1200
Industry	680	760	70	830	40	800
Total	1770	2040	60	2100	-40	2000
IV Utility	1120	1620	0	1620	-170	1450
Industry	910	1000	100	1100	70	1070
Total	2030	2620	100	2720	-100	2520
V Utility	1860	2260	0	2260	-80	2180
Industry	1420	1580	130	1710	20	1600
Total	3280	3840	130	3970	-60	3780
VI Utility	690	1330	50	1380	-110	1220
Industry	930	1030	240	1270	-630	1660
Total	1620	2360	290	2650	520	2680

TABLE 11: Projected NO_x Emissions From Utilities and Industries by Region (10³ Tons) (Cont)

Federal Region	1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
VII Utility	440	680	0	680	-30	650
Industry	430	470	30	500	30	500
Total	870	1150	30	1180	0	1150
VIII Utility	170	450	0	450	-40	410
Industry	200	230	30	260	20	250
Total	370	680	30	710	-20	660
IX Utility	300	380	0	380	-50	330
Industry	460	510	40	550	70	580
Total	760	890	40	930	20	910
X Utility	40	50	0	50	-30	20
Industry	190	210	30	240	80	290
Total	230	260	30	290	50	310
National						
Utility	6560	8980	30	9010	-780	8200
Industry	6000	6640	710	7350	1010	7650
Total	12560	15620	740	16360	230	15850

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Appendix 1: EMISSIONS PROJECTIONS ASSUMING NSPS^{1/}

This Appendix contains the results of Case 4 of the analysis defined in Section II (See Table 3). This represents application of NSPS rather than BACT as assumed in Case 2 for all of the 1985 cases. Both regional and national results are provided below. Only TSP and SO₂ are included because the NO_x case presented in the paper assumes NSPS.

Table A-1. NATIONAL EMISSIONS FROM INDUSTRIES AND UTILITIES - NSPS
(10⁶ Tons)

<u>PARTICULATES</u>				
	<u>1975</u>	<u>1985 BASELINE</u>	<u>1985 COAL PROGRAM</u>	<u>1985 PRESIDENT'S PROGRAM</u>
INDUSTRY	11.2	11.4	11.8 (4%) ^{2/}	11.7 (3%) ^{2/}
UTILITY	3.1	1.2	1.3 (8%)	1.2 (0%)
TOTAL	14.3	12.6	13.1 (4%)	12.9 (2%)
<u>SULFUR DIOXIDE</u>				
	<u>1975</u>	<u>1985 BASELINE</u>	<u>1985 COAL PROGRAM</u>	<u>1985 PRESIDENT'S PROGRAM</u>
INDUSTRY	10.8	12.4	16.6 (34%) ^{2/}	15.9 (28%) ^{2/}
UTILITY	18.6	20.2	20.2 (0%)	18.2 (-10%)
TOTAL	29.4	32.6	36.8 (13%)	34.1 (5%)
<u>NITROGEN OXIDES</u>				
	<u>1975</u>	<u>1985 BASELINE</u>	<u>1985 COAL PROGRAM</u>	<u>1985 PRESIDENT'S PROGRAM</u>
INDUSTRY	6.0	6.7	7.3 (9%) ^{2/}	7.6 (13%) ^{2/}
UTILITY	6.6	9.0	9.0 (0%)	8.2 (-9%)
TOTAL	12.6	15.7	16.3 (4%)	15.8 (1%)

^{1/} New Source Performance Standards for units above 25 MW. For specific emission limits under NSPS, see Case 4 for TSP and SO₂, and case 1 for NO_x in Appendix 2.

^{2/} Percentage over 1985 baseline.

TABLE A-2 PROJECTED TSP EMISSIONS FROM INDUSTRIES AND UTILITIES BY REGION - (NSPS)
(10³ TONS)

	FEDERAL REGION	1975 ACTUAL	1985 BASE	CHANGE COAL PROGRAM (from 1985 base)	1985 COAL PROGRAM	CHANGE PRESIDENT'S PROGRAM (from 1985 base)	1985 PRESIDENT'S PROGRAM
I.	UTILITY	40	30	0	30	0	30
	INDUSTRY	210	220	0	220	0	220
	TOTAL	250	250	0	250	0	250
II.	UTILITY	120	50	0	50	-10	40
	INDUSTRY	550	560	10	570	10	570
	TOTAL	670	610	10	620	0	610
III.	UTILITY	510	100	0	100	0	100
	INDUSTRY	1280	1300	20	1320	10	1310
	TOTAL	1790	1400	20	1420	10	1410
IV.	UTILITY	1050	260	10	270	-10	250
	INDUSTRY	2490	2540	40	2580	10	2550
	TOTAL	3540	2800	50	2850	0	2800
V.	UTILITY	990	400	0	400	-10	390
	INDUSTRY	3040	3090	60	3150	-40	3050
	TOTAL	4030	3490	60	3550	-50	3440
VI.	UTILITY	130	150	20	170	10	160
	INDUSTRY	1210	1230	180	1410	260	1490
	TOTAL	1340	1380	200	1580	270	1650
VII.	UTILITY	190	110	0	110	-20	90
	INDUSTRY	1040	1060	20	1080	20	1080
	TOTAL	1230	1170	20	1190	0	1170

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TABLE A-2 PROJECTED TSP EMISSIONS FROM INDUSTRIES AND UTILITIES BY REGION - (NSPS) (Cont)
(10³ TONS)

FEDERAL REGION	1975 ACTUAL	1985 BASE	CHANGE COAL PROGRAM (from 1985 base)	1985 COAL PROGRAM	CHANGE PRESIDENT'S PROGRAM (from 1985 base)	1985 PRESIDENT'S PROGRAM
VIII. UTILITY	80	90	0	90	-10	80
INDUSTRY	400	410	10	420	10	420
TOTAL	480	500	10	510	0	500
IX. UTILITY	30	40	-10	30	0	40
INDUSTRY	660	670	20	690	20	690
TOTAL	690	710	10	720	20	730
X. UTILITY	-	10	0	10	0	10
INDUSTRY	330	330	10	340	0	330
TOTAL	330	340	10	350	0	340
NATIONAL						
UTILITY	3140	1240	20	1260	-50	1190
INDUSTRY	11200	11410	370	11780	300	11710
TOTAL	14340	12650	390	13040	250	12900

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TABLE A-3 PROJECTED SO₂ EMISSIONS FROM INDUSTRIES AND UTILITIES BY REGION - (NSPS)
(10³ TONS)

	FEDERAL REGION	1975	1985	CHANGE	1985	CHANGE	1985
		ACTUAL	BASE	COAL PROGRAM (from 1985 base)	COAL PROGRAM	PRESIDENT'S PROGRAM (from 1985 base)	PRESIDENT'S PROGRAM
I.	UTILITY	220	400	0	400	-40	360
	INDUSTRY	230	260	50	310	-20	240
	TOTAL	450	660	50	710	-60	600
II.	UTILITY	780	760	10	770	-110	650
	INDUSTRY	590	680	60	740	60	740
	TOTAL	1370	1440	70	1510	-50	1390
1-4 III.	UTILITY	3120	2810	-20	2790	-180	2630
	INDUSTRY	1500	1720	250	1970	130	1850
	TOTAL	4620	4530	230	4760	-50	4480
IV.	UTILITY	5010	5200	-60	5140	-730	4470
	INDUSTRY	2060	2360	520	2880	120	2480
	TOTAL	7070	7560	460	8020	-610	6950
V.	UTILITY	7550	6410	-200	6210	-360	6050
	INDUSTRY	3730	4280	500	4780	230	4050
	TOTAL	11280	10690	300	10990	-590	10100
VI.	UTILITY	160	1970	220	2190	-40	1930
	INDUSTRY	690	790	2280	3070	2990	3780
	TOTAL	850	2760	2500	5260	2950	5710
VII.	UTILITY	1300	1760	0	1760	-290	1470
	INDUSTRY	660	760	180	940	160	920
	TOTAL	1960	2520	180	2700	-130	2390

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TABLE A-3 PROJECTED SO₂ EMISSIONS FROM INDUSTRIES AND UTILITIES BY REGION - (NSPS) (Cont)
(10³ TONS)

FEDERAL REGION	1975 ACTUAL	1985 BASE	CHANGE COAL PROGRAM (from 1985 base)	1985 COAL PROGRAM	CHANGE PRESIDENT'S PROGRAM (from 1985 base)	1985 PRESIDENT'S PROGRAM
VIII. UTILITY	240	400	0	400	-60	340
INDUSTRY	230	260	100	360	80	340
TOTAL	470	660	100	760	20	680
IX. UTILITY	180	400	10	410	-100	300
INDUSTRY	980	1130	110	1240	150	1280
TOTAL	1160	1530	120	1650	50	1580
X. UTILITY	40	110	0	110	-50	60
INDUSTRY	140	160	120	280	80	240
TOTAL	180	270	120	390	30	300
NATIONAL						
UTILITY	18600	20220	-40	20180	-1960	18260
INDUSTRY	10810	12400	4170	16570	3520	15920
TOTAL	29410	32620	4130	36750	1560	34180

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Appendix 2: METHODOLOGY FOR EMISSIONS CALCULATIONS IN THE INDUSTRIAL SECTOR

The general methodology for industrial emissions calculations begins with PIES fuel use estimates for industries under the NEP and a 1975 and 1985 baseline. The 1985 baseline is then modified to reflect changing fuel use. This discussion will describe:

- (1) Baseline Emissions.
- (2) Emission Factors, and
- (3) Assumptions Used in the Regulation Cases

(1) Baseline Emissions

Industrial baseline air emissions are affected due to the variable levels of baseline emissions under the different regulatory assumptions for each case as well as the direct impacts of coal conversion. The NSPS baseline emissions for fuel combustion are determined using the current applicable State Implementation Plan (SIP) emission limitations for existing sources and new sources with less than 25 megawatts (MW) heat input capacity. New Source Performance Standards (NSPS) are applied to new facilities with greater than 25 MW capacity. The baseline change is then calculated as the difference in baseline air emissions which would result when compared to fuel combustion emissions under the NSPS baseline case.

The total industrial emission baseline, which includes fuel combustion as an emission source, is calculated for each pollutant by using 1985 projected national emissions ^{1/} to derive that portion of the national figures which originate from industrial sources. This industrial breakout is obtained by applying the 1975 distribution of emissions for all sources ^{2/} to the 1985 totals and computing that portion which is projected to originate in the industrial sector.

^{1/} Priorities and Procedures for Development of Standards of Performance for New Stationary Sources of Atmospheric Emission, Argonne National Laboratory, for EPA, EPA-450/3-76-020, May 1976.

^{2/} Data from EPA's National Emissions Data System.

(2) Emission Factors

The derivation of emission factors to calculate change in air emissions from conversion of oil and gas to coal involves:

- . For the SIP regulations for coal and oil, regional emission limits were developed using AQCR-specific regulations which are aggregated to the regional level by weighting with the relative industrial fuel combustion for each AQCR.^{1/} The oil emission factors also assume that distillate oil represents a minimum of 30 percent of the oil savings through conversion which decreases the overall level of air emissions from oil burning before conversion. Gas emission factors have been developed^{2/} using EPA data for all three pollutants.^{3/}
- . For the NSPS regulations, national standards were used as promulgated by EPA.^{3/}
- . For coal burning in new facilities three different assumptions were used to project potential air impacts under EPA's Best Available Control Technology (BACT) air regulations. Various levels of SO₂ and TSP control efficiency are explained with the assumptions for each specific case. Operating and maintenance practices are assumed adequate to maintain stated control efficiencies. Non-compliance with applicable environmental regulations is not considered a factor in the air impact analysis.

^{1/} Laws and Regulations Affecting Coal, for the U.S. Department of Interior, Energy and Environmental Analysis, Inc., June 1976.

^{2/} AP42, Compilation of Air Pollutant Emission Factors, EPA Second Edition, February 1976.

^{3/} 40 CFR 60 Standards of Performance, Subpart D, revised 40 FR 46250.

- For oil burning in new facilities, a moderate desulfurization policy and TSP control strategy were assumed to calculate air emissions. These emissions are deducted from coal burning emissions to compute the incremental change due to conversion.
- For NO_x emissions in new facilities with 25 MW or greater capacity, boiler design and operating procedures were applied to reduce flame and furnace temperatures and increase the amount of excess air in the flame to attain the NSPS national emission standards.

Non-boiler fuel combustion is assumed to use the same air emission factors which have been developed for fuel combustion in boilers.

(3) Assumptions in the Regulatory Cases

Several different regulatory cases were constructed to reflect potential variations in the Clean Air Act and in the definition of BACT. These cases are summarized in Table 2 of the analysis document. The discussion below provides more detail on the assumptions for each pollutant.

Sulfur Dioxide

Case No. 1. BACT is applied on new facilities with greater than 25 MW capacity to achieve a 90 percent reduction in SO₂ emissions (this assumes 90 percent efficiency and 100 percent reliability of scrubber equipment). Also, a 20 percent reduction through coal cleaning is obtained in the sulfur content of the most locally abundant coal available within each FEA region. An emission limit of 1.5 pounds per MMBtu is set for new facilities with 10-25 MW capacity, assuming 25 percent of the units use FGD and the remaining burn low sulfur coal. A BACT emission limit of .53 pounds per MMBtu is used for oil-burning. In comparing the emissions results for the Coal Conversion and President's Programs, the decrease in emissions observed in the President's Program is primarily due to oil to gas fuel switching which occurs with the conservation policies of the National Energy Plan.

Case No. 2. The same assumptions are used as in Case No. 1, except for new facilities with greater than 25 MW capacity, where an 80 percent reduction in SO_2 emissions is achieved instead of 90 percent (this assumes 90 percent reliability instead of 100 percent).

Case No. 3. The same assumptions are used as in Case No. 2, except for new facilities with 10-25 MW capacity. Coal burning in these units is assumed to be regulated by applicable SIP SO_2 emission limitations instead of 1.5 pounds per MMBtu.

Case No. 4. This case assumes the attainment of the NSPS regulation of 1.2 pounds per MMBtu for coal burning in facilities with greater than 25 MW capacity. All other assumptions are the same as in Case No. 3. Case No. 4 in effect assumes attainment of the same environmental standards used to compute the NSPS baseline emissions from industrial fuel combustion.

Total Suspended Particulates

Case No. 1. BACT is applied to limit TSP emissions to .01 pounds per MMBtu in new facilities with greater than 25 MW capacity. This assumes a 99.8 percent reduction in TSP using a baghouse or electrostatic precipitator (ESP). For new facilities with 10-25 MW capacity, TSP emissions are limited to .03 pounds per MMBtu, which assumes a 99.5 percent reduction. This BACT for small new facilities requires use of a baghouse or ESP, since it is unlikely that a scrubber for SO_2 will achieve this degree of TSP removal. A BACT regulation of .05 pounds per MMBtu is used for oil. TSP emissions from gas are assumed to be .017 pounds per MMBtu (from AP42).

Case No. 2. The same assumptions are used as in Case No. 1, except for TSP emissions from coal, where an effective limit of 0.5 pounds per MMBtu is assumed. This emission regulation achieves a 99.0 percent reduction in TSP, which can be obtained with an SO_2 scrubber, or a baghouse or ESP if no scrubbing is necessary.

Case No. 3. The same assumptions are used in Case No. 3, except for new facilities with 10-25 MW capacity, where applicable SIP regulations apply for coal combustion. This case assumes 92 to 97 percent TSP reduction under current SIP's, using either a baghouse or ESP.

Case No. 4. This case assumes attainment of the NSPS for new facilities greater than 25 MW capacity, which allows emissions of .1 pounds per MMBtu. In effect, the emission regulations for this case are identical to the standards used for the TSP baseline for industrial fuel combustion.

Nitrogen Dioxide

Case No. 1. This one case for NO_x uses emission factors developed from AP42^{1/} for oil (.40 pounds per MMBtu), gas (.69 pounds per MMBtu), and coal (.75 pounds per MMBtu) for existing facilities and new facilities of 10-25 MW capacities. For new facilities greater than 25 MW capacity NSPS regulations apply for oil (.3 pounds per MMBtu), gas (.2 pounds per MMBtu) and coal (.7 pounds per MMBtu).

^{1/} AP42, Compilation of Air Pollution Emission Factors, Second Edition, February 1976.

Appendix 3: METHODOLOGY FOR EMISSIONS CALCULATIONS IN THE UTILITY SECTOR

This Appendix describes the methodology used to calculate emissions in the utility sector. These estimates were provided by the Energy Strategies Branch (ESB) of the Office of Air Quality Planning and Standards of EPA. A separate report is under preparation by ESB documenting their projections.^{1/}

I. COMPUTATION OF BASELINE EMISSIONS

Baseline emissions are (1) 1975 emissions of SO₂, particulates, and NO_x from all sources (total emissions) and from power plants, and (2) 1985 emissions of SO₂, particulates, and NO_x from power plants. The 1985 baseline emissions are termed "business as usual," which assumes continuance of the regulatory and legislative environment prior to the proposed National Energy Plan or other legislation currently being considered for increased coal use. All emissions were aggregated by State, EPA region, and the Nation.

A. 1975 Emissions

Emissions of SO₂ from power plants were obtained from the Energy Data System (EDS). EDS calculates SO₂ emissions based on the type, amount, and sulfur content of fuels actually burned in each power plant (as reported on the 1975 FPC Form 67 and assuming 98 percent of input S is emitted as SO₂). Emissions of NO_x and particulates for power plants were obtained from the National Emissions Data System (NEDS), which reflects 1975 data for about 40 states and somewhat older data for the remainder of the country. Adjustment was made for a known error in the NEDS file for the State of Florida.

Total emissions for SO₂, particulates, and NO_x in 1975 were obtained from NEDS (as of March 21, 1977). Total SO₂ emissions were adjusted by replacing the NEDS SO₂ emissions for electric generation with SO₂ emissions from power plants calculated using the Energy Data System. This adjustment was made for two reasons:

^{1/} "Air Pollution Impacts of Increased Coal Use in the Utility Sector: An Analysis of Emissions Under the National Energy Plan."

- (1) to provide a consistent baseline of power plant emissions (the estimates of 1985 power plant emissions were based on EDS); and
- (2) because, on a national basis, EDS data is more current than NEDS.

B. 1985 Emissions

Power plant emissions in 1985 were estimated using the model depicted in Figure A-1. In general, emissions were computed assuming that existing sources in 1975 would meet existing State Implementation Plan (SIP) emission regulations for 1985. Emissions from units which are planned to

Figure A-1. Model for Estimating 1985 Power Plant Emissions
(SO₂, Particulate, NO_x)

1985 Power Plant Emissions	=	Maximum Allowable Emissions Existing Sources	-	Emissions From Retired Units	+	Emissions From New Sources	+	Emissions from Fuel Switching
						Gas Curtail- ments	ESECA	Other Dual- Fired

be retired between 1975 and 1985 were subtracted. Emissions from planned new units were added along with increased emissions from existing units which are likely to convert from burning oil or gas. The following paragraphs discuss the assumptions, data sources, and procedures for computing each of the elements depicted in Figure A-1.

Maximum Allowable Emissions for Existing Sources

For SO₂, maximum allowable emissions (MAE) for existing (in 1975) coal- and oil-fired units were computed by EDS assuming that each power plant meets the applicable

SIP regulation for 1985. SIP regulations in EDS were those effective as of January 1977. No adjustment was made to account for the possibility of revised SIPs in the future since the impact of such revisions (toward either tightening or loosening regulations) is difficult to predict.

For particulates, MAE for coal-fired power plants were computed by EDS in the same manner as SO₂ emissions were calculated. For oil-firing, however, 1985 emissions were assumed to be the same as 1975 since most oil burners today emit particulates at a rate well below that required by SIPs.^{1/} To have assumed that all oil-burners meet SIP levels in 1985 would have resulted in a substantial and unrealistic increase in particulate emissions between 1975 and 1985.

For NO_x, MAE were assumed to be the same as emissions in 1975, because only Los Angeles and Chicago have NO_x regulations which limit emissions from existing sources.

Retirements

Power plant retirements (in megawatts) were determined on a State basis using data from FPC Order 383-3 (April 1, 1976). Retired megawatts were converted to fuel amounts using national average heat rates (BTU/kw-hr) as computed by FPC and a 0.60 capacity factor.

For SO₂ and particulates, emissions from retired coal and oil units were computed by assuming a drop in 1985 maximum allowable emissions proportional to the reduction in fuel use brought about by retirements.

For NO_x, 1985 emissions by fuel use were not available. Therefore, emissions from retired units were computed using a national weighted average emission factor (#NO_x/unit fuel use) for coal, oil, and gas. The average emission factor for each fuel type was based on published EPA emission factors^{2/} and 1973 capacity of tangentially-fired boilers versus other types of firing (as reported to FPC).

1/ Comparison of FPC fuel quality data with SIP emission regulations in EDS.

2/ Compilation of Air Pollution Emission Factors, AP-42, US EPA, April 1976.

Emission from New Sources

Planned growth in the power plant sector was that reported on FPC Order 383-3 in April 1976, and subsequently updated by FPC through mid-March 1977. Fuel use for this growth was calculated using a national average heat rate (Btu/kw-hr) for coal as provided by FPC and a 0.60 capacity factor. For the "Business as Usual - NPS" case all growth was assumed to meet the current Federal new source performance standards^{3/}, except where SIP regulations for particulates and SO₂ were more stringent than the NSPS. For the "Business as Usual - BACT" case, BACT was assumed to be 80 percent control of input sulfur assuming use of locally available coal, 0.05 #particulate/MMBtu, and 0.6 #NO_x/MMBtu. BACT was assumed to apply to units coming on line in or after 1984.

For the NSPS and BACT case, this approach, to a small degree, may underestimate emissions of SO₂, since some new plants coming on line after 1975 are not subject to NSPS. Emissions of NO_x and particulates probably would not be underestimated since, over the past few years,^{4/} most new power plants typically emit at levels near the NSPS.

Emission From Fuel Switching

The potential fuel-switchers were identified from three sources of information. One source was the Federal Energy Administration's lists of what that agency terms "Round I" and "Round II" candidates for prohibition orders (limiting the use of oil or gas as primary boiler fuel) authorized by the Energy Supply and Environmental Coordination Act (ESECA) of 1974. For this analysis, it was assumed that all of the Rounds I and II boilers would burn only coal by 1985. A second group of potential fuel-switchers were identified from boiler fuel-use data in the Energy Data System. It was assumed that any boiler which used both coal and oil in 1975 would burn only coal by 1985. The third source of information was the Foster Associates' study of gas curtailments

^{3/} 1.2 #SO₂/MMBtu; 0.1 #particulate/MMBtu; 0.7 #NO_x/MMBtu

^{4/} Data collected by EPA's Emission Standards and Engineering Division for work on revising NSPS.

done under SASD contract. This study identifies the power plant boilers which can burn either gas and oil or gas and coal, and estimates, through 1980, how much gas-burning will be curtailed in these boilers because of natural gas shortages. These estimates were extended through 1985 using a report sponsored by the gas industry.^{5/} For these boilers, it was assumed that those which can burn coal would convert to coal, and those which cannot burn coal would convert to oil. Some boilers are designed for multi-fuel use, but cannot, without considerable cost, be restored to a previous coal-burning capability. For this set of boilers, it was assumed that coal-burning capability would be restored only in those identified by FEA as conversion candidates. Although some boilers designed to burn only gas are being converted to oil use (conversion to coal is impractical for such boilers), these conversions were not considered, since no hard data are available on the location and extent of such conversions.

The changes in emissions that will result from fuel switching were computed on a plant-by-plant basis by subtracting 1975 base year emissions from projected 1985 emissions after switching fuels. Base year SO₂ emissions came from an Energy Data System program (described earlier) which operated on the types of fuels used and their sulfur contents. Base year particulate matter and NO_x emissions were derived from the National Emissions Data System which uses either measured emissions or emission factors from AP-42 (Compilation of Air Pollution Emission Factors, US EPA). To estimate 1985 SO₂ emissions, it was assumed that all coal and oil would be burned in compliance with applicable SIP regulations. To estimate 1985 particulate matter emissions, the same assumption was made for coal-burners, but for those sources which will switch from gas to oil, the AP-42 emission factor for oil-burning was used. The reason for this assumption was that, while most states apply the same particulate emission limit for both coal-burners and oil-burners, oil-burners rarely emit particulates up to the allowed limit. To estimate 1985 NO_x emissions, emission factors were applied to boilers switching from oil or gas to coal. For boilers switching from gas to oil, the

^{5/} "Future Gas Consumption of the United States," Volume No. 6, University of Denver Research Institute, September 1976.

1985 emissions were assumed to be the same as those in 1975. The reason for this assumption was that, based on AP-42 emission factors, the change in NO_x emissions is near zero when switching from gas to oil and is highly dependent on the heating values assumed for the two fuels.

In computing the 1985 emission limits for SO₂ and particulate matter, it was assumed that replacement fuels equaled replaced fuels on a total heat input basis. Exceptions were made where inspection data on ESECA boilers (gathered by PEDCO Environmental Specialists, Inc. under SASD contract) showed that oil-to-coal switching resulted in either boiler derating or increased boiler efficiency, both of which would result in lesser coal heat input.

II. COMPUTATION OF EMISSIONS IMPACT OF THE NATIONAL ENERGY PLAN

Future changes in fuel use patterns resulting from the proposed National Energy Plan were furnished from the PIES model. This section describes the assumptions used to translate changes in "business as usual" fuel use into changes in "business as usual" emissions of SO₂, particulates, and NO_x.

For this project, PIES forecasted (on an EPA regional basis) changes in consumption of coal, oil, and gas that may occur in 1985 and 1990 if the economic policies of the National Energy Plan are implemented. Two sets of estimates were provided -- one for the coal substitution portion of the Plan and one for the impact of the entire program (including coal substitution and conservation). Fuel use data were expressed in heat equivalents (Btus).

Increased coal consumption was assumed to be in newly constructed units, and thus the associated emission increases were computed both at the NSPS emission rates (1.2 #SO₂/MMBtu, 0.1 #particulate/MMBtu, and 0.7 #NO_x/MMBtu) and at BACT emission rates (90 percent control SO₂, 0.05 #particulate/MMBtu, and 0.6 #NO_x/MMBtu). Decreases in coal consumption under the total NEP were assumed to be by reduction in the construction of planned new units. Decreased emissions were

computed at both the NSPS and BACT emission rates. Exceptions to this assumption were made where projected NEP decreases in a given time period exceeded the projected "business as usual" growth for the same period. In this situation some of the reduced consumption was assumed to be in a projected growth (meeting NSPS or BACT) and some in existing units (meeting SIP).

Decreases in oil or gas consumption were assumed to be the result of retirements or fuel conversions and, thus, would affect plants that were on line in 1975 (thus meeting SIPs at the time the action took place). Accordingly, emission decreases were computed using a weighted average SIP emission limit for each pollutant by region. This weighted average SIP was determined by dividing the maximum allowable emissions for existing (in 1975) sources (in tons/year) by the total regional fuel use (in Btus). (Maximum allowable emissions had been calculated for estimation of the 1985 "business as usual" emissions by assuming that each power plant existing in 1975 met applicable SIP emission limits for 1985). Increases in oil consumption were assumed to be as a result of boiler conversions from gas to oil-firing, since no new oil-burning plants were being built. It had been assumed that fuel switching in all dual-fired boilers -- where replacement fuels are subject to SIP emission regulations -- would take place under "business as usual." Any additional conversions from gas to oil would require boiler modifications, and, thus, it was assumed that increased oil use under the NEP would be subject to NSPS.

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Mr. DINGELL. The time of the gentleman has expired.

The Chair now recognizes the gentleman from Tennessee, Mr. Gore, for 5 minutes.

Mr. GORE. Thank you, Mr. Chairman.

Welcome, Dr. Schlesinger. It is always a pleasure to hear your testimony up here. I heard you talk about the need for unity in the country and I agree with that too. I have listened to all of the witnesses we have had here during these hearings from different industries, from the gas industry, from the utility industry, and it is amazing how almost everyone of them started out their testimony by saying "We applaud the President's initiative, and we think the overall program is just wonderful. There are, of course, some specific difficulties that we have."

When you add all those specific difficulties up, it amounts to a major political problem.

One of the biggest political problems in this subcommittee, to be quite frank about it, is going to be the battle over deregulation of natural gas. Assuming we are asked to vote on a bill with a very liberal definition of new gas, that does not include incremental pricing, what in your opinion would be the impact on this country of deregulating natural gas in that manner.

Mr. SCHLESINGER. The administration's bill has, I think, been quite generous on the question of oil and gas pricing. The cap which

is suggested is higher than it has been everywhere except the State of Texas, which has certain peculiar features.

The difference between deregulation and the bill which the President proposes amounts, in our projections, to \$120 billion between now and 1985 in additional revenues for the gas industry, \$120 billion. It moves up to approximately \$25 billion.

Mr. GORE. One hundred and twenty billion dollars. Eighty percent of that will go to about 25 companies?

Mr. SCHLESINGER. It would be concentrated, yes, sir.

Mr. GORE. So these are pretty high stakes. When you are talking about a regional interest being placed in the way of the President's bill, this is a big one.

I was frankly surprised to find out when I came to the Congress that deregulation had as much support here as it does because I can't really reconcile it with the public interest. It seems incredible to me.

That \$120 billion figure must assume a pretty large cost per Mcf on the so-called "free market." What is your prediction as to how high the cost per Mcf would rise?

Mr. SCHLESINGER. About \$2.50 per Mcf in constant dollars. Otherwise, it would be higher than this. We can insert for the record the annual effects. It runs from about \$5 billion in 1978 to \$25 billion in 1985, the cumulative effects are about \$120 billion.

Mr. GORE. By 1985 we would be talking about an annual revenue to these companies of \$25 to \$30 billion each year.

Mr. SCHLESINGER. These are constant dollars. You can apply whatever rate of inflation you wish. If you think the rate of inflation will be zero, it will be \$25 billion in 1985.

Mr. GORE. I won't make that assumption, Doctor.

Now, what supply response over and above that projected in the President's plan would come from this kind of deregulation, given the limitation on drilling capacity? We are currently right up against a ceiling on drilling capacity, as I understand it.

Mr. SCHLESINGER. You have indicated the nature of the problem. There might be some response on the gas side because the producers would go for gas rather than oil. That doesn't solve our national problem. But, putting that aside, given the fact we are increasing the number of rigs at as substantial a pace as we can, and that existing rigs are fully employed at the present time, the short-time response would be small. In the intermediate term, we would have a slightly larger response, but at the expense of longer-term production.

Now, on the other side—

Mr. KRUEGER [presiding]. The time of the gentleman has expired. He may complete the question and the answer; and that will be the last.

Mr. GORE. How do you justify the rollover figures in the plan if the \$1.75 figure for new gas is supposed to be sufficient to provide incentive and capital for exploration? It seems like a large give away to me.

Mr. SCHLESINGER. There is no give away. The interstate contract is permissive of a rise to as high as \$1.42 if it is necessary to maintain production, but there is no requirement, indeed there is

no predilection, toward raising that price to \$1.42. This would permit a continuation of production but we would not anticipate all those interstate contracts went up. And, of course, there are similar provisions with regard to the intrastate market, which would go to \$1.75.

One could argue about the discrepancy between old intrastate and old interstate contracts. The answer is we did not think it appropriate to roll back the price on intrastate contracts to \$1.42.

Mr. GORE. Thank you, Mr. Chairman.

Thank you, Doctor.

Mr. KRUEGER. Recognizing, in order of appearance, Mr. Stockman.

Mr. STOCKMAN. Dr. Schlesinger, I would like to follow up on that \$120 billion figure a little bit. It is a rather inflammatory number and I am sure there will be exchanges during debate. But you will have to admit that it is misleading in that it is based on a \$2.50 price assumption for new natural gas which will generate a certain incremental amount of conventional gas we would not otherwise have. We don't know, either one of us, what it is.

But if you don't have the incremental increase in production you will still have the demand for use in the economy and the additional costs are going to be basically SNG and LNG imports.

You were talking about \$120 billion going to domestic producers and that is bad, but it would seem even worse having it go to SNG stocks or LNG imports which will go to Algeria and other foreign producers.

So it seems to me the \$120 billion figure might be right, but where are the alternatives and where will those cash or revenue flows be going?

Mr. SCHLESINGER. The points you are making are well taken in a number of respects. We desire to avoid making use of LNG imports or synthetic natural gas at \$4 per Mcf if we can produce natural gas at \$2 or \$2.25.

The \$120 billion figure was not intended to be inflammatory. It was in response to Mr. Gore's question.

The \$2.50 price, actually \$2.45, I believe, runs a little bit higher than the emergency sales of last winter. We would expect, as a practical matter, that given the disproportionate difference between demand and supply the price would be less than \$2.45. We think that is probably a modest estimate for gas. But this is not different with regard to allocation questions, it is different with regard to equity considerations. Everybody in the industry will grant that \$1.75 is a price at which they are going to make a great deal of money. It is an appropriate incentive price. It will probably bring out substantial effort by the industry. The industry is now almost fully employed in expanding the number of rigs. It has doubled the number of rigs since 1973. We have in the legislation the opportunity to remove any controls from deep or tight formations if it is necessary to have a higher price. Our problem is that, given the imbalance in this market, those prices could go sky high. Last winter they could have gone to \$3 or \$3.50. As the chairman and I discussed, this would have had a grave consequence of rolling into the interstate market gas from Texas, it would have wreaked rapid

havoc in the State of Texas. For that reason, there was a desire on the part of the Texas legislators to avoid that result.

This may be regarded as a first step towards deregulation. If we are able to prove up the technologies to which the present chairman, Mr. Krueger, referred, then we may take further steps toward deregulation.

Mr. STOCKMAN. As the real price for gas rises, it will take more income from the economy. It drops down to whether it will go to foreign or domestic producers.

I think there is a very self-defeating cycle generated here and that is because the prospects are modest for domestic production. I think it could be documented. I would like to hear from you as to the outflow of our drilling rigs and seismic crews into Indonesia and other places where foreign natural gas may be liquefied and sent back to this country. What sense does that make?

Mr. DINGELL. The gentleman's time has expired.

Mr. SCHLESINGER. It makes relatively little sense. The issue is equity. It is not an issue of the advantages of a higher price. We have doubled the number of drill rigs in the course of the last 4 years as a result of dramatic increases in price of both oil and gas to this point. We will continue the limitation on the importation of liquefied gas on a case-by-case basis. In the case of synthetic gas, of course, the impact would be on American income but it would be at a higher price.

We certainly desire to have a reasonable maximum flow of natural gas. The \$1.75 maximum price is higher than the prices which have prevailed in the intrastate market until last December, with the sole exception of Texas, and there are peculiar features in the Texas market. There are renegotiation clauses and renegotiation clauses which ratchet up the prices but do not permit them to recede.

But if you might look at the other States—Louisiana only missed \$1.75 during last winter's natural gas shortage. So that is a generous incentive price.

Mr. DINGELL. The Chair recognizes the gentleman from Illinois, Mr. Madigan.

Mr. MADIGAN. Dr. Schlesinger, you indicated, I think in response to the question by the gentleman from Texas who was in the Chair, that your agency had made estimates as to the increases which would occur in sulfur dioxide emissions from the coal conversion you are hoping to accomplish with the program. I assume those estimates are based on maintaining the standards for ambient air quality.

Mr. SCHLESINGER. Those estimates should be compared to the ambient air standards, but those estimates are based simply upon the impact on the atmosphere of this coal conversion program.

The assumption has been that we would retain the ambient air standards. However, the estimates are independent of that.

Mr. MADIGAN. In the testimony we have had on the obstacles that seem to stand in the way, according to the witnesses, in implementing any major coal conversion effort, is the environmental regulations which exist at the State level, State implementation plans addressing an air quality plan in one part of the State; impose restrictions in other parts of the State.

What should the Congress do with the problems as to State implementation plans for air quality?

Mr. SCHLESINGER. Usually one says one is happy that you raised that question, Congressman. I can't say that in this particular case.

I have no easy advice to offer to the Congress as to the difference in the State plans and the ambient air quality standards. I feel the ambient air standards, given the nature of the crisis we face, are appropriate as a benchmark.

Mr. MADIGAN. It would be your position that you would and perhaps we should allow coal conversion so long as the conversion doesn't result in a violation of the national primary and secondary air quality standards.

Mr. SCHLESINGER. I think I will have to hesitate with regard to endorsing that. I gave my personal judgment a moment ago but I don't know whether or not the Congress would desire to override State implementation plans. I would have to reflect on that matter for sometime before I could give that kind of concrete advice to you, Mr. Madigan.

Mr. MADIGAN. I am assuming you have had some opportunity to reflect on the criticisms directed at the program. As you reflect on those, do you feel the President's program should have greater emphasis on coal gasification and desulfurization plants?

Mr. SCHLESINGER. We will work as hard as we can on desulfurization. With regard to degasification, we are prepared to subsidize new technologies should they be promising. With regard to existing technologies such as the Lurgi projects, we wish to avoid such subsidization. We don't want to exclude it, but we wish to delay it for awhile.

With regard to the plant on the West Coast, it would seem all expense would be borne by the State of California; and it would seem appropriate that the State of California apply the cost rather than it being loaded onto the taxpayer at large. Those are existing technologies. I think such plants should be built but it is an institutional matter, not technological.

Mr. MADIGAN. The electric generating people indicate the coal conversion part of this program could impose a capital requirement upon them between now and 1985 of some additional \$50 billion, which they indicate an inability to generate. They suggest either rate reform or some kind of government assistance to obtain that capital.

Have you any suggestion as to the proper direction for Congress to take?

Mr. SCHLESINGER. They are looking at one part of this program. For new construction our estimate runs \$35 billion. But the effective rate reform by squaring up loads will reduce the requirement for additional generating capacity on the order of something like \$40 to \$75 billion.

In order to pay for whatever capacity expansion is necessary, there will be generated a substantial flow of funds through the tax on oil and gas used by utilities. That will pay for some significant part of that conversion program. We expect virtually all of that funding to be used. It is about \$6 billion of the \$35 billion.

Mr. DINGELL. The time of the gentleman has expired. The Chair recognizes Mr. Walgren, the gentleman from Pennsylvania.

Mr. WALGREN. I wanted to pursue the thought that the administration came into office, I think, being relatively open as to the feeling that natural gas should be deregulated for a trial period of about 5 or 6 years. At least I have seen statements by President Carter to that effect.

Now, we have your statement that this price is a first step toward deregulation. This sort of indicates there is some continuity of that change.

I wonder if you could really pinpoint just what exactly it is that resulted in that change? I suspect it is in the area of facing such a shortage that you are actually moving toward altering the capital stock and trying to set up a system where capital is, in fact, not going to go toward the development of the delivery of more natural gas. I suppose there is an awful lot of invasion of the pure free market setting of price by supply and demand in that once you have made the assumption you are going to alter the capital stock, it would be justified.

I wanted to give you the opportunity to try to take me through the conversion of the President's and the administration's position from the pure deregulation into what you feel we face now.

Mr. SCHLESINGER. On the first point, we went through last winter's natural gas crisis which brought changes in perspective on the part of many parties. I mentioned earlier the attitude of legislators from Texas who didn't want to see that big interstate market overwhelming the intrastate market.

We have a potential demand for natural gas of some 30 trillion cubic feet per year. We are fighting to maintain production of 20 trillion cubic feet per year. This is a market which was exacerbated by the effects of last winter's severe weather. Everybody who went through last winter's experience recognizes the imbalance. We hope that if some of the technologies mentioned by Mr. Krueger are brought in we will have better balance between supply and demand. Until that time, we have moved toward deregulation. We are permitting the Btu equivalent price; we are taking steps to produce gas from tight and deep formations, and from geopressurized brine and Devonian shale. As long as this market is in such imbalance, I don't think it appropriate to take any further steps.

What we have is a tremendous growth of the economy and, in relation to that growing economy, a relative shortage of oil and gas. We will have to make an adjustment in our use of energy irrespective of regulation or deregulation: Stationary sources increasingly are going to have to make use of coal. Unless we make an adjustment, we will face a point in the future where that transition may be forced upon us painfully and forcefully. We are talking about a substance whose lifetime is 30 years. You can't bring about suddenly a change from oil and gas to coal. But we shall have to make use of more coal, and it is more convenient for industry to use oil and gas. That is our problem.

Mr. WALGREN. I yield back the balance of my time.

Mr. DINGELL. Mr. Brown.

Mr. BROWN. You indicated the technology was not there for geopressurized shale. I believe ERDA has completed a development.

Mr. SCHLESINGER. Yes.

Mr. BROWN. And California Standard has also undertaken this.

We had testimony from Houston Power and Light that they were doing experiments. Even the utility which testified before us from Mississippi indicated they are studying that. The Universities of Texas and Louisiana are on the development question as well.

At the recent Reston meeting set up by ERDA there was substantial pressure by the geomethane group to the effect that the technology was there to develop these rather large resources. I believe there is no question the resources are there.

I understand the estimates per Mcf cost ranged anywhere from \$5 to as low as \$2.

We had a speech here in this complex of buildings by Dr. Bernath from the United Nations, who says his estimate is \$2.50. He is not a fly-by-night. I think he was Mr. Geothermal of 1975, or whatever.

My question is, why do we want to put a lid on natural gas with this vast resource just over what the price horizon is?

One final comment. I understand the most recent request for conventional natural gas pricing was \$2.45 and \$2.36 from the developer of natural gas in Texas in February of 1977.

That is why I am disturbed at our natural gas policy.

Mr. SCHLESINGER. Mr. Brown, I think I can in large measure reassure you on that. The natural gas policy, of course, applies to conventional flowing gas. If the price necessary to bring it out is \$3, we are prepared to deregulate geopressurized brine.

Mr. BROWN. On a case-by-case basis?

Mr. SCHLESINGER. No, we are prepared to remove from deep and tight formations, Devonian shale—

Mr. DINGELL. Would you include coal seam gas, Doctor.

Mr. SCHLESINGER. I think so, Mr. Chairman.

Mr. DINGELL. I don't want to force you to take a hard position this morning.

Mr. SCHLESINGER. Generally speaking, the natural gas pricing refers to the very low cost gas which comes from existing reservoirs or provable reservoirs. The returns to the producers are not to be determined by these new technologies. However, we are prepared to see that the price is right for those new technologies.

Mr. BROWN. Are you prepared to make the commitment before or after the fact? I happen to know there are a lot of people who do not trust the government that much.

Mr. SCHLESINGER. We can promulgate a rule; in fact, it is in section 104.

We have the environmental problem of disposing of tens of thousands of barrels a day of water which is highly saline. We can't dump it into the Gulf of Mexico; we have to develop technologies for disposing of that water and determine the corrosive effects of that highly saline water on equipment. We can produce it in an R&D way, but the rest of the problems remain to be solved.

Mr. BROWN. One of the publications on the Hill states I am tough on energy people by asking difficult questions.

I am surprised the administration did not ask for an environmental impact statement on the whole business, because the conversion of coal will have a significant impact.

I might ask, why did you eschew the opportunity?

Mr. SCHLESINGER. I did not regard it as an opportunity to be seized.

Mr. BROWN. My question was, why not?

I would like to submit one other question for the record, if I may.

Mr. DINGELL. So ordered. The record will remain open.

The gentleman from Massachusetts, Mr. Markey.

Mr. MARKEY. I yield 20 seconds of my time to Mr. Gore.

Mr. GORE. Thank you.

Mr. Schlesinger indicated he would be prepared to submit for the record figures and information over and above the President's request.

Mr. DINGELL. Without objection, the information requested will go in at the appropriate place. [See p. 74.]

The time of the gentleman from Massachusetts is running.

Mr. MARKEY. On the Today Show, I heard you talk about the energy industry and you said they were a greedy lot.

Mr. SCHLESINGER. The interrogator stated that to be a proposition and asked if I agreed with it. I stated that sometimes I agreed but not on that particular occasion.

Mr. MARKEY. How about today?

Mr. SCHLESINGER. Usually when I feel that way, I feel that way privately.

Mr. MARKEY. Assuming right now the innermost soul has gravest reservations about the energy industry and talking about the \$1.75 natural gas price as very generous, I was wondering what you would think would be a generous allocation for the gas industry. What would be the minimum?

Mr. SCHLESINGER. We have to recognize the need to bring together the intrastate and interstate market. The effort of the FPC to bring the cost to \$1.42 was designed to provide a generous incentive price when that decision was made by the FPC a year ago.

In general, let me state that in the course of recent years, gas has gone from 13 cents per Mcf to a prospective \$1.75 per Mcf. Even from a base of 26 cents per Mcf, you have a seven-fold increase in the price of gas. As a result of the actions of the oil-producing countries, whose governments have imposed taxes of \$11, approximately, \$11 to \$11½ per barrel, world oil prices have quadrupled. That is why we have the activity in the oil industry. We are offering for frontier oil \$13. Those are prices the industry would not have dreamed of a number of years ago. Indeed, as I mentioned earlier, the National Petroleum Council told us 4 years ago that at a price of \$6 we would have all the oil we would ever need. That price is now on the order of \$10. These are very generous prices, indeed. The argument is not about the incentive; it is whether the old oil should also give to the producers the OPEC price, and that is a question on equity ground, on which I think we should all have grave misgivings.

Mr. MARKEY. We don't have any projected figures yet from the administration as to the new revenues which will accrue to the producers from the new prices, yet the administration talks about no new prices accruing as windfall profits. Do you have anything to back up that statement?

Mr. SCHLESINGER. We have nothing which would indicate there would be no windfall profits. They will be minimized by the wellhead tax which will generate at its peak something on the order of \$15 billion a year. The profits for the industry will continue to grow. As under the base line case in 1985, the oil industry will be making \$9.5 billion in profits in 1985, as compared to \$3.5 billion in 1972.

That will be lower than it would have been in the base line case and far lower than if we had deregulation of crude oil.

Mr. MARKEY. I agree with you. The oil company figures, themselves, show they are doing quite well. The administration is calling for a new system of gathering information as to the type of profits the industry is making. I was wondering why we don't delay until you gather this information.

Mr. DINGELL. The Chair will permit the witness to respond, Doctor. The gentleman's time has expired.

Mr. SCHLESINGER. We wanted to establish for the industry planning a formula which is stable. That has been our aspiration. I am not sure the industry has wholly endorsed stability when instability would benefit the position of the industry.

But it has been our objective to establish a set of price levels according to which the companies can make their calculations. On new oil they have said, "Yes, indeed. We will have the world price." Whatever decision the Congress makes, it should include as much stability for the industry as it can.

Mr. DINGELL. The Chair recognizes one of the members of the full committee, Ms. Barbara Mikulski.

Ms. MIKULSKI. As to the cost of actually delivering services, I wonder if that was ever given consideration?

Let me express my concern. It would cost the mayor of Baltimore, Detroit, or Chicago more money to run police cars or heat schools. Then that mayor has to make a decision to either cut services or raise the property tax, which would have a tremendous impact on the local government.

Did you look at this aspect and what were your thoughts? Were any assistance programs thought of, particularly to large cities?

Mr. SCHLESINGER. The complaint has been made about this plan with some degree of validity, that the burden of the plan and particularly of the higher cost of transportation falls on people in rural areas. This turns out to be a city-oriented plan rather than a rural-oriented plan. The benefits do go to urban areas.

As to the impact on State and local governments, we have looked at State funding of highways, for example, and have indicated we would open up the Highway Trust Fund to the States, so the burden on them of the decline in gas tax receipts would be alleviated.

There are other provisions in this plan to assist State and local governments and the institutions which serve in local areas, in increasing the efficiency of their use of energy. So there is something in this, but we didn't go into the matter in the depth which you suggest with regard to alleviating the problems of local municipal finances.

Ms. MIKULSKI. Do you share with me the fact this can have an enormous impact? If you think of the family who will be hit by

increased residential utility bills, you might have to pay a hidden tax for energy and increased taxes. No mayor wants to choose between hiring teachers or keeping kids warm, or hiring psychiatrists and keeping patients warm.

Mr. SCHLESINGER. We agree. We have a task force for the study of additional legislative requirements. But with regard to utility bills, the effect of this bill will be to reduce the cost of utilities to the household consumer. We are attempting to protect consumers by not exposing them to any tax and by incremental pricing. Those households who use fuel oil will be protected against the increase in fuel oil prices resulting from the crude oil equalization tax. So we have attempted to avoid some of the difficulties to which you quite correctly refer.

Ms. MIKULSKI. So the administration is not thinking of any kind of energy countercyclical aid?

Mr. SCHLESINGER. We will be exploring a range of additional legislative proposals in the course of the years ahead. That may be appropriate.

Ms. MIKULSKI. I would hope this would be pursued.

This country is thriving because it has enjoyed a large voluntary social service program. I wonder if there was any thought given to this. For example, the impact of the program such as "Meals on Wheels" which has extraordinary impact on institutionalization of handicapped.

Mr. SCHLESINGER. That will be a major feature, but we don't have direct assistance for the alleviation of higher gasoline prices for such institutions as you suggest.

But let me suggest once again, we can avoid that gasoline tax. This is a challenge to the American people. We all know we can reduce our gasoline consumption and thereby avoid the tax if we all make the effort.

Mr. DINGELL. The Chair recognizes Mr. Moore.

Mr. MOORE. Dr. Schlesinger, when you were last here we asked you send to the committee information from your office about the fact how much natural gas the \$1.75 cap would produce or whatever information you have on that score and also you indicated deregulation would produce appreciably no new natural gas. I would like to renew my request at this time for that.

Mr. SCHLESINGER. That has been sent up, Mr. Moore.

It may be lost in transition but it has been prepared.

Mr. MOORE. We appreciate that.

Although I was not here, I have been informed the comment was made that deregulation would produce \$120 billion to natural gas producers over what they would ordinarily receive over the next 10 years.

Mr. SCHLESINGER. According to the President's plan, which contemplates an increase of \$15 billion in natural gas producers as compared with the present legislation.

Mr. MOORE. These are gross receipts?

Mr. SCHLESINGER. Yes, sir; and cumulative.

Mr. MOORE. How was the figure arrived at?

Mr. SCHLESINGER. The assumed price was \$2.45 on a constant dollar basis, and it was also assumed there would be a 5-year rollover of all existing contracts.

Mr. MOORE. Would you produce for us that information to show us how that came about?

Mr. SCHLESINGER. Yes. If you would like to change the assumptions, we are prepared to run the calculations for a different set of assumptions.

Mr. MOORE. The gentleman from Michigan wants me to yield.

Mr. STOCKMAN. I said before this is an inflammatory figure. Unless you are talking about deregulating totally flowing gas, there is no way you can get that figure. If you are to get \$120 billion you would have to be talking about 240 Tcf. The only way to get that figure is to assume all the flowing gas is going to be at \$2.50. Not one of us has ever suggested that old gas be rolled over or deregulated.

Mr. SCHLESINGER. But the assumption is that all new wells are going to get the deregulated price, and new wells will be run into the same pools very simply, by the producers. It is very easy to put more straws in the soda.

Rather than being an inflammatory figure, that is a very modest figure. If there had been any contemplation of using an inflammatory figure, we would have used a current dollar figure. If you want to assume a rate of inflation of 7 percent between now and 1985, then indeed those figures will be staggering. But deregulation of all new wells would result in the drilling of new wells which would go into existing reservoirs, and in 5 years' time we would have a rollover of all gas.

Mr. STOCKMAN. The bill we have doesn't contemplate the rollover of the old gas. Surely that is far more limited.

Mr. SCHLESINGER. We are prepared to run these calculations with whatever assumptions any member of the committee would care to make; and, of course, the effects will be different; but I think it is quite obvious that higher prices, a more generous definition of new gas, and the ability to rollover contracts are all going to increase the aggregate take of the industry.

Mr. DINGELL. The time of the gentleman has expired.

Doctor, the Chair and the staff have some questions. I understand you have some time problems which we respect. We thank you and your associates for your assistance and kindness to us.

[The following letter and attached report were received for the record:]

THE WHITE HOUSE
WASHINGTON

May 9, 1977

Dear Mr. Dingell:

I am enclosing an analysis of the economic and budgetary consequences of the National Energy Plan. This statement has been developed by Administration officials with responsibilities for economic, budget and energy policies.

In order to complete such an assessment, final legislative proposals were required as a starting point. It was necessary to examine not only individual proposals, but also their overall interrelationships and the direct and indirect consequences for economic growth, prices, employment, budget impact and other factors. The results were then carefully scrutinized by the appropriate agencies to ensure the assessment would be as accurate as possible.

The results are described in the enclosure. The statement not only provides specific estimates of the impacts of the Plan, but also attempts to make explicit uncertainties where they exist. As the analysis indicates the economic impact is neutral to positive in most respects. The Plan would have a modest net inflationary impact, the specific size of which would depend on whether the standby gasoline tax is triggered. The budgetary impact of the Plan through 1985 is modest in terms of the cumulative impact on the Federal deficit. This is a relatively small price to pay for building a sound foundation for the Nation's continued growth throughout this century.

Sincerely,

James R. Schlesinger
Assistant to the President

The Honorable John Dingell
United States House of Representatives
Washington, D.C. 20515

OVERALL ECONOMIC AND BUDGETARY IMPACTS
OF THE NATIONAL ENERGY PLAN

There are attached the analyses of the overall economic impact and of the budgetary impact of the National Energy Plan. These analyses, prepared by the Administration officials responsible for economic, budget and energy policy, assess the economic and budgetary consequences of the detailed proposals in the National Energy Plan on April 29.

The analysis of the overall economic impacts of the National Energy Plan covers the period 1978 through 1981, and describes the expected results of the Plan with what would otherwise occur. The uncertainties and difficulties in making an economic forecast are elaborated. Because of its standby nature and its impact on the economy, the analysis separates the effects of the Plan with and without the standby gasoline tax.

After reviewing the effects of the major components of the Plan, the overall economic analysis for the 1978-1981 period concludes that the Plan will have no significant impact on the growth of real Gross National Product (GNP) or unemployment. The Plan will have a measurable, but modest net inflationary impact of 0.3 to 0.4 percent annually over the next two years and 0.1 to 0.3 percent annually over the following two years. These forecasts recognize the uncertainties of the amount of new proposed taxes which will be passed through into consumer prices, OPEC pricing decisions, and transitional effects.

While there is considerable hope that the gasoline tax will not be triggered in the period analyzed, an assessment has been made assuming the tax is triggered each year, beginning in 1979. In that event, prices would be expected to increase by an additional 0.2 to 0.3 percent. The impact on real GNP would be slightly contractionary, though this finding is so small as to be difficult to assess within the general accuracy of the forecast.

The cumulative budgetary impact of the National Energy Plan has been assessed through 1985. Like the economic forecast, it is subject to considerable uncertainty, particularly beyond 1981. The cumulative net effect of the Plan's proposals over the period is expected to have a relatively neutral effect on the Federal deficit.

of the Plan's proposals over the period is expected to have a relatively neutral effect on the Federal deficit. Outlays are estimated to increase about \$50.4 billion through 1985, while cumulative revenues are projected to increase about \$51.3 billion over the same period.

The budgetary consequences of the Plan increase the outlays and the deficit in the near-term, offset later by increasing tax revenues. In 1978, outlays would increase by \$1.76 billion, offset by increased revenues of \$0.31 billion, thereby adding \$1.45 billion to the deficit.

In a separate, but related matter to the Plan, re-estimates of receipts for the Naval Petroleum Reserves are projected to decrease Federal receipts, with the amount of the decrease to be fixed based on future decisions. This adjustment would increase the Federal deficit over the period.

OVERALL ECONOMIC IMPACTS OF THE NATIONAL ENERGY PLAN.

The Administration has now completed an assessment of the overall economic impact of the National Energy Plan. The purpose of the analysis is to estimate the effects of the Plan on the major macroeconomic variables, relative to what would otherwise occur through 1981. Given the state of economic forecasting, these estimates are, at best, suggestive. It is exceedingly difficult to forecast the precise response of the economy to a comprehensive restructuring of a vital sector. Notwithstanding these difficulties, the following represents current findings.

Base Case Assumptions

In estimating the effects, the following assumptions have been made about the "base case." In line with recent trends, the composite price of domestic crude oil was assumed to rise at 10 percent annually until it reached the world price. Natural gas prices were assumed to follow existing FPC regulations. OPEC oil prices were assumed to rise at the same rate as the general price level.

Effects of Major Components of the Plan

The economic impacts of the major items in the Plan (in current prices unless otherwise stated) are:

- o The oil pricing rules and wellhead oil tax: The new pricing regulations and wellhead oil tax would have the effect over time of lowering the average producer prices on oil and raising the user prices. The Plan's net effect on oil prices is expected to add approximately \$5 billion to expenditures on oil products by 1981.
- o The gas-guzzler tax: The effect of the gas-guzzler tax would be to shift the demand for new automobiles from fuel-inefficient, relatively expensive cars to fuel-efficient, relatively inexpensive cars. However, some of the savings due to the shift to more fuel efficient cars may be offset by cost increases necessary to achieve better fuel efficiency.

Several econometric models have been used to estimate the net effects. Assuming that the share of imported cars is unaffected by the gas-guzzler tax and rebate, a small increase is expected in the number of vehicles sold accompanied by a very small reduction in the total real dollar value of sales for the automotive industry.

- o The conservation tax on oil and gas: Beginning in 1979, taxes would be levied on major industrial and commercial users of oil and gas. Total Treasury revenues net of rebates for qualified investment for coal conversion would reach \$5 billion by 1981. Some of the inflationary effects of the conservation taxes are expected to be offset by the rebate for coal conversion.
- o Investment: The National Energy Plan will in some cases induce, in others mandate investment in equipment and structures to replace those now burning oil and gas. Since investment behavior is difficult to predict, the assumptions used in this analysis are very conservative. There should be positive impacts from consumer expenditures on insulation, as well as industrial coal conversion. These may be offset, however, by lower utility investments in new capacity as more efficient use made of generating capacity through peak load pricing. In any case, the effect on total net investment will be between 0 and \$2 billion annually over the next four years.
- o The gasoline tax: There is considerable hope that the President's gasoline consumption goals can be achieved without triggering the standby tax over the period of the present analysis. If it were triggered and the revenues recycled as proposed, the effect on the overall economy will be to accelerate the movement from fuel-inefficient to fuel-efficient automobiles. In addition, there may be some decline in total vehicle miles traveled. Overall, a fractional increase in the rate of inflation in those years that the tax is triggered would occur. Some economic models also foresee

that there will be a slight drag on the economy as a whole. Even with real incomes maintained by the rebates, rising gasoline prices would induce somewhat lower automobile sales. In the past, decreases in automobile sales have, in part, increased consumer savings rather than going completely into other consumption expenditures.

Overall Assessment of the National Energy Plan

In analyzing the overall effect of the Plan, the results have been divided into two parts: (A) the Plan without triggering the standby gasoline tax; and (B) the effects of triggering the gasoline tax.

(A) Assessment of the Plan Without the Gasoline Tax

In making the assessment, the results have been divided for the period 1977 to 1979 and for 1979 to 1981. The reason for choosing these periods is that the year to year variations in output growth and inflation are sensitive to assumptions about the exact timing of taxes and rebates; and these are subject to some uncertainty as to exact details and economic impact.

- o The impact of the Plan will have no significant impact on the growth of real GNP or upon unemployment over the next four years. Depending on the exact econometric model used and upon the sub-period, the estimated effect ranges from minus 0.1 percent to plus 0.1 percent on the annual growth rate of real GNP. There is so little impact on real output because the program changes the relative prices of energy to non-energy products without changing the real aggregate demand.
- o The Plan will have a measurable, but modest net inflationary impact. Over the next two years (Calendar Year 1979 over Calendar Year 1977), the annual rate of inflation would be 0.3 to 0.4 percent higher than it would otherwise be. In the subsequent two years, the price impact would be smaller, with an increase in the annual inflation rate of about 0.1 to 0.3 percent.

There are several uncertainties in the overall economic evaluation of the Plan.

- o The assessment assumes that two-thirds of the wellhead taxes will be passed through into increased product prices. This view is at variance with the results from some of the macroeconomic models which assume implicitly that all of the tax will be passed through to prices, sometimes with an additional mark-up. However, it seems more likely that profit margins at the refinery will be reduced because of the pressure of world markets on U.S. prices.
- o In this assessment, it is assumed that OPEC pricing will be unchanged by the Plan. It is reasonable to expect, however, that over the next decade, reduced U.S. dependency on imported oil will induce OPEC to restrain price increases. If OPEC price increases were moderated by only 1 percent per annum over the next 10 years, this would offset a sizable fraction of the inflationary impact of the program.
- o It is recognized that the Plan will cause some transitional effects on the economy over the next few years. For example, the automobile industry will need to move more strongly toward fuel efficient vehicles. Industries that are induced or mandated to convert to coal may experience problems in conversion or in obtaining the necessary expertise and equipment. The impact of these effects will require monitoring, but are not expected, overall, to be large.
- o What will be the effects on the economy while the country is debating the Energy Plan? There may well be some temporary reactions to the Plan as investors and firms sort out their own reactions and wait for final Congressional action. While this is unavoidable, an effort has been made to minimize such reactions by proposing that the major tax credits and rebates be made retroactive.

(B) Impact of the Gasoline Tax Alone

Although there is considerable hope that the gasoline tax will not be triggered over the period under examination, an analysis has been performed of the impact of the tax on the assumption that it is triggered each year, beginning in 1979.

- o The annual rate of inflation over the period 1977 to 1981, as measured by the GNP deflator, would be 0.2 to 0.3 percent higher than otherwise. The major uncertainty in this figure is the extent to which wages and other prices would respond to such an increase.
- o It is expected that the gasoline tax would have a slight contractionary effect. Over the period 1977 to 1981, the annual growth rate of real GNP would be between 0.0 and 0.2 percent lower than would otherwise occur. This results from a projected reduction in vehicle miles driven which extends the life of the automobile stock and lowers automobile sales. These reduced automobile sales could be potentially offset, however, if the gasoline tax reinforces the gas-guzzler tax and rebate and spurs consumers to acquire fuel-efficient cars more quickly.

Conclusions

In any program as comprehensive and far-reaching as the National Energy Plan, there are difficulties in precisely forecasting the economic effects. The Plan will increase the rate of inflation by a modest amount. But there is no way to increase prices for oil and gas to their value without having an effect on the overall price level. The most that can be done to ameliorate this effect is to spread the inflation out over time. In addition, the effect on economic growth is minimal over the next four years covered by this analysis. However, if the assessment proves faulty, steps can and will be taken to ensure that the economy stays on the desired growth path. The basic strategy of the Plan is to lay the foundation for healthy and sustainable growth, one based on energy sources which are dependable, environmentally acceptable, and in sufficient abundance to be used for many years to come. The transitional problems of price increases and industrial adjustments are the costs of laying the foundation for stable growth for the rest of this century.

BUDGET IMPACT OF THE NATIONAL ENERGY PLAN

The attached table contains estimates of budget outlays and revenue impacts associated with the President's proposals. The estimates shown cover the eight-year period through fiscal year 1985. The estimates are subject to considerable uncertainty, particularly in the years beyond fiscal year 1981.

Cumulative additions to budget outlays through 1985 are projected at \$50.4 billion. These increases are in addition to outlay estimates transmitted to the Congress in April 1977. During the same eight-year period, the President's energy proposals will bring in additional new revenues of about \$51.3 billion. When these new revenues are offset against budget outlays, the net impact on the deficit through 1985 is a positive \$0.9 billion. In short, the cumulative net budgetary effect of the Plan's proposals over the period is expected to be roughly neutral.

Key items influencing budget outlays include the proposal to expand the Federal strategic oil stockpile to 1 billion barrels and an adjustment for the overall inflationary effect of the energy proposals on Federal programs whose spending levels are closely linked to changes in the cost of living. In addition, the estimates include the direct payments to individuals from the revenues collected from the crude oil tax, not otherwise returned through tax credits. The estimates also include the taxes and rebates for the auto efficiency ("gas guzzler") tax. It should be noted that no net budget effect results from these taxes since net revenues will exactly offset outlays. The most significant item affecting net revenues is the oil and natural gas conservation taxes, which would be levied under the President's plan beginning in 1979 on high volume industrial users for continued use of oil and natural gas. This tax will increase revenues by \$40.34 billion through 1985, even after rebates have been paid to industries for the costs of converting to coal.

In fiscal year 1978, the energy proposals will add an estimated \$1.45 billion to the deficit, reflecting the fact that anticipated tax revenues will initially lag behind budget expenditures associated with the President's proposals. Specifically, budget outlays are estimated to increase by \$1.76 billion offset by increased revenues of \$0.31 billion.

In addition to the new initiatives set forth in the National Energy Plan, estimates have also been revised for receipts for the Naval Petroleum Reserves. Prior estimates assumed continuing production at Elk Hills. The availability of Alaskan oil and the projected surplus on the West Coast makes previously planned production at Elk Hills undesirable, at least until additional pipeline or refinery capacity is available. Accordingly, previously expected revenues will be foregone, with the losses to be determined in subsequent decisions. This adjustment will have a negative impact on the Federal deficit through 1985.

Cumulative Effect of Energy Plan on
Federal Expenditures and Tax Revenues - Fiscal Years 1978-1985
(Billions of Current Dollars)

	Budget Outlays ^{1/}	Revenue Impact ^{1/}	Net Impact
I. President's Energy Plan			
Conservation:			
Energy Conservation Retrofit.....	- 2.25	- 3.94 ^{2/}	- 6.19
Additional Revenue Costs to Meet			
90 Percent Insulation Goal.....	-	- 2.94 ^{2/}	- 2.94
Tax Credit for Commercial/			
Industrial Efficiency.....	-	- 2.20	- 2.20
Tax Credit for Solar.....	-	- 0.55	- 0.55
Tax Credit for Geothermal.....	-	- 0.18	- 0.18
Cogeneration.....	-	- 0.73 ^{3/}	- 0.73 ^{3/}
Standby Gasoline Tax.....	-	-	-
Auto Efficiency Tax.....	- 7.70	+ 7.70 ^{4/}	- 4/
Crude Oil Tax.....	-13.39	+13.39 ^{4/}	- 4/
Tax on Motorboat/Aviation Fuels....	- 0.03	+ 0.50	+ 0.47
Federal Building Retrofit.....	- 2.67	-	- 2.67
Solar Heating in Federal Buildings.	- 0.10	-	- 0.10
Oil and Gas Pricing.....	- 0.38 ^{5/}	-	- 0.38
Increased Federal Fuel Costs.....	- 2.90	-	- 2.90
Increased Coal Use:			
Electric Utilities.....	-	+ 0.31	+ 0.31
Industrial.....	-	+40.34	+40.34
Energy R&D.....	+ 2.03	-	+ 2.03
Strategic Petroleum Reserve.....	-11.03	-	-11.03
Assistance to Poor.....	- 0.40 ^{6/}	-	- 0.40
Indexing - Federal Program Payments..			
Tied to CPI ^{7/}	-11.15	-	-11.15
Other.....	- 0.40 ^{8/}	- 0.45 ^{8/}	- 0.85
Total President's Program.....	-50.37	+51.25	+ 0.88
II. Other Energy Impacts			
Naval Petroleum Reserves: ^{9/}			
(low estimate).....	- 1.90		- 1.90
(high estimates).....	- 5.86		- 5.86

Footnotes attached

Footnotes

- 1/ Conventions used for amounts shown under the budget outlays column are that a minus sign indicates increase in total outlays; under the tax receipts column, a minus sign indicates lower tax receipts; and under net impact, a minus sign indicates an adverse impact on the budget. These are tentative estimates which will subsequently be subject to a detailed budget review. This review could result in changes. The amounts shown are in addition to the President's budget estimates transmitted to Congress in April 1977.
- 2/ As reflected in the first entry, the tax incentive may prove inadequate to achieve the conservation goal. As reflected in the second entry, a mandatory program initiated later may be necessary to achieve the President's goal.
- 3/ If triggered, the tax revenues would be fully rebated. In the worst case and the full 50 cents came into effect over ten years, \$152.8 billion would be collected and rebated.
- 4/ There would be no net budget effect since tax revenues offset the outlays. The crude oil tax amounts are the portion of that tax to be returned to the public through direct Federal payments. The remainder will be returned via tax credits. Total revenues collected through 1985 are estimated to be \$86.6 billion.
- 5/ Previous budget estimates assumed end of all regulation and are now not budget consistent with President's recommendations.
- 6/ Estimate assumes occasional emergencies of a regional character due to serious weather or spot shortages; but estimate does not assume a major embargo or repetition of 1976-77 severe winter.
- 7/ Includes effect of the energy program initiatives on Federal pay and on Federal programs indexed to the cost of living including social security, civil service and military retirement, food stamps and school lunch programs. Price increases beyond 1981 not included.
- 8/ Includes utility pricing, interconnections and wheeling, information systems, appliance efficiency, mandatory building standards, fuel efficiency standards, fuel economy for the Federal fleet, fuel economy for light-duty trucks, removal of excise taxes on intercity buses, and repeal of minimum tax in IDC's.
- 9/ Estimated receipts from production of oil at Elk Hills will be lower than indicated in previous budget estimates, the extent of which will be determined by future decisions. This is necessary to reduce the surplus of oil on the West Coast. The low estimate shown is based on NPR production resuming at the minimum economic recovery rate in FY 1981. The high estimate is based on not resuming production at the minimum economic recovery rate through FY 1985.

Mr. DINGELL. Our next witness is Mr. William D. Nordhaus, Member, Council of Economic Advisers.

If you would, like your brother who sat here first.

**STATEMENT OF WILLIAM D. NORDHAUS, ACCOMPANIED BY
PHILIP K. VERLEGER, JR., PH.D., COUNCIL OF ECONOMIC AD-
VISERS, EXECUTIVE OFFICE OF THE PRESIDENT**

Mr. NORDHAUS. The first question I would like to raise is, Have you asked the right Nordhaus to testify before you this morning?

Mr. DINGELL. I think the White House has straightened that out.

Mr. NORDHAUS. A member of our staff was supposed to have sent up 100 copies of our testimony. In any case, I have a handful for any members who don't have them.

Mr. DINGELL. The Chair does observe that you have an associate. Will you identify him?

Mr. NORDHAUS. With me is Dr. Philip Verleger. He is with me today to help answer the tough questions which this committee is reputed to ask.

Mr. DINGELL. In view of time constraints, we would be agreeable to placing your full statement in the record, which you may summarize, if you will.

Mr. NORDHAUS. I would like to highlight a couple of the points in my testimony that were not included in earlier testimony of Chairman Schultze. If I may take leave to discuss that I will do that at this time.

In my prepared testimony I discuss three aspects of the energy program, focusing mainly on the economic questions. The subject is not only the effects of passing the President's program but, in addition, I tried to say something about the potential economic problems if we don't have an effective program.

In the first section I review the overall economic impacts we have put together for the short run. These are, I think, at this point, pretty well known. I will pass over those at this time. But the estimates we have made give predicted effects on the economy assuming, contrary to the usual expectation, that no adjustments will be made during the period under consideration.

As we noted, we expect there to be modest impacts on the economic condition of the country because of the various tax and rebate provisions. But let me remind the committee, we have counteracted the effects of the higher taxes by offsetting or, the word you have often heard, recycling. We have reduced other taxes with the increase in wellhead and potential gasoline taxes and, therefore, because of this, the Federal taxes in 1981 will be essentially unchanged. That is a point I think worth stressing.

Another question I would like to point out to you is a question which has been asked of the CEA. Why do we accept an energy plan which is inflationary? I would think we have to be quite open about this. The answer is that one of the cornerstones of the plan is conservation, and to make conservation effective we must raise oil and gas prices so that various consumers, industry, and government as well, will have incentives to reduce their consumption. However, the higher prices are a one-shot adjustment. They have been phased

in a way that is consistent with the twin goals of conservation and economic recovery, goals that are shared by the administration and the Congress. We very much hope, and I can't emphasize this enough, that no one will mistake this one-shot inflation for an inflation caused by excess demand for goods and services. They are very different.

I will pass over the effects on investment and imports and comment on something which I think has not received enough attention; that is, the question of the effect of the plan on the potential output or high employment output of the economy.

It should be noted that most of the economic impact estimates which have been put forth by the administration and private forecasters refer only to the impact of the plan as to the overall demand for goods and services and not supply. There is a wide margin of error in these forecasts.

It is misleading to talk only about short-term circumstances. A sound energy policy is necessary to insure that we have a continued healthy recovery, that we don't curtail the output of our factories or compel our members to remain idle because of the need for fuel. This is the most wasteful of restraints, rather, the program is designed to lay the foundation for smoother, more secure, sustainable, less risky, and more efficient economic growth over the coming decades.

I think I will pass over in my verbal remarks the discussion of coal conversion as one of the cornerstones for the medium-term policy. This committee is fully aware of the provisions of the bill and the incentives, which will be in place if the bill is passed as proposed, to convert from oil and gas to alternative energy sources, coal being the example I have used. What I have tried to do in the two tables on pages 17 and 19 is to show what will happen to the total cost for selected products with and without the President's program. These are techniques vitally different than those used before, but which may be more useful.

If you look at table 1 you will see that if the President's program is passed there will be significantly lower costs for products if all industries convert to coal than if they do not. This is because of the combination of oil and gas conservation taxes and conversion credits built into the program.

So, roughly speaking, if you look at what happens to costs of major industries in 1985, relative to 1975, if you convert to coal, the price increase due to higher energy prices will be roughly half than if you do not convert.

Page 19 of the testimony shows the same calculations with current law and it shows no incentive to convert to coal, roughly speaking, under the assumptions we use. If you convert to coal you have costs almost three times higher than if you don't. I think these tables could help us clear up some of the questions in many people's minds as to why coal conversion didn't occur earlier.

In short, the systems of taxes and tax credit on industrial energy consumption is designed to encourage strongly the use of coal. It uses market incentives as a way of ensuring that the medium term objective of coal conversion is attained.

Finally, I refer to a question I have heard many times: Why the urgency? Why is the President asking sacrifice? And why now?

There are two parts to this. The first part of the answer is that the economy of the United States is becoming increasingly exposed to future oil shocks. If we are to have a healthy economy over the time to come this risk should be reduced. I have heard little debate and there are few people who would question that premise. The second part is an economic fact of life: The sooner we act the lower the costs of converting from oil and gas.

Turning to the first point on the question of exposure, you are, I am sure, familiar with the projections of the National Energy Plan as to imports. The National Energy Plan estimates the share will rise from 19 percent in 1976 to 24 percent in 1985. That is a considerable increase in the import share of our consumption. I think this is not poetic license. In a recent review of five medium term projections for 1990, I calculated that on average they predicted no fall in the share of imports over the foreseeable future. With the measures the President has proposed, however, the National Energy Plan projects a fall from 19 to 14 percent.

You might ask why is this such a big deal, and it's tempting to paint a lurid picture of the future catastrophes. But I think these must either give bad ideas to those who might be tempted to help bring on the catastrophe, or else they sound a little far-fetched. So I am going to put it slightly differently.

I will simply ask what has happened over the last 4 years? Remember that our exposure will be increasing during the next 10 years unless we act, so let's just ask what has happened over the past 4 years as a result of the considerable exposure we have had to oil shocks.

First, in 1973, a short oil embargo, and it was relatively brief, against the United States, curtailed millions of barrels of imports. According to one study, an FEA study, this led to a loss of \$20 billion, just that embargo, of GNP in 1974—in 1972 prices.

Second, in 1973-74, as you know, oil prices quadrupled, sending the world economy into the worst recession since the Great Depression. According to the last Council of Economic Advisers, the United States has produced \$375 billion less in output in this recession, in the 1974 to 1976 period, than our potential GNP, and those are in 1976 prices.

Mr. DINGELL. Did you say \$375 billion or millions?

Mr. NORDHAUS. Billion, as in bill. That would be approximately 30 percent higher in current prices. It is projected by most analysts that we will not regain our productive potential until the early 1980's. Those are very big numbers.

Third, I am sure I don't have to remind this committee about the winter of 1977, and of the cumulative effects of natural gas shortages which, at the peak, laid off nearly 2 million workers. And I think it is not widely recognized that the winter was not that severe a winter. I don't think that is widely known. It had approximately 10 percent more degree days than normal. I was at the meeting that Mr. Krueger referred to a few minutes ago of the American Geophysical Union yesterday afternoon, at which there was considerable discussion of the global cooling problem. It is clear that we are on a down trend as is the rest of the world. It is not a precipitous drop in world temperatures, but this is superimposed on the normal weather variation.

I would say 1977 is a one in three or four winters, it's not a 1 in 200 or 1 in 100, as has often been suggested.

The fourth point is that in 1976 we spent \$32 billion for imported oil and in 1977 we were running almost 50 percent above the same period last year. Our oil imports contribute to a significant imbalance in the global balance of payments.

Without asking what is going to happen over the next 10 years, I would say just what has happened in the last 4 years and the four points I mentioned should be enough to convince most people that we are in an exposed position, and that the sacrifices and structural changes asked for by the President pale beside the enormous and unforeseeable risk we run if we do not act.

Finally, I would just summarize the last point: Why don't we wait a bit longer? I think the answer both from technical studies and economic studies is that it is cheaper to convert now or to change our ways now rather than in the future.

There are some examples in there. So to summarize the major points: First, the energy plan is designed to lay the foundation for an economic growth path based on energy supplies which are secure, clean, and economic. At the same time, however, the taxes and rebates are designed to minimize any negative impact on the economy in the short run.

Second, one cornerstone for reducing consumption of oil and gas is the coal conversion program. By raising oil and gas prices to their replacement cost to the Nation, and using some of the proceeds as rebates for conversion, powerful incentives will be put in place for industry to decrease its utilization of oil and gas.

Finally, if we are to ensure an orderly and efficient transition from the area of cheap oil and gas, we must act now. Failure to do otherwise would increase our exposure to energy shocks and increase the cost of transition at that point when delay is no longer possible.

Mr. Chairman, that summarizes my summary of the testimony which I will submit for the record.

[Testimony resumes on p. 114.]

[Mr. Nordhaus' prepared statement follows:]

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL OF ECONOMIC ADVISERS
WASHINGTON, D.C. 20506

TESTIMONY OF

William D. Nordhaus, Member
COUNCIL OF ECONOMIC ADVISERS

BEFORE THE

SUBCOMMITTEE ON ENERGY AND POWER
HOUSE OF REPRESENTATIVES

June 1, 1977

Mr. Chairman, I am particularly pleased to appear before you today. I would like to use this chance to explain the economic impacts of implementing the Energy Program. I would also like to say something about the potential economic problems of not having an effective Energy Program.

My testimony will cover three separate aspects of the energy program. First, I will review with you the Administration's projection of the impact of the Energy Plan on the overall economy over the next four years. Second, I will discuss one of the cornerstones of the medium-run strategy, the coal conversion program. Finally,

I will end by discussing the costs and benefits of having an effective energy program over the long run.

Overall economic impact in the short-run.

Our short-run assessment of the overall impact of the President's program on the economy focuses upon the impact during the period out to approximately 1981. We will give an estimate of the effects on the economy assuming, contrary to the usual expectation, that no adjustments will be made to economic policy over this period. We perform this exercise mainly to examine what, taken by themselves, are the consequences of the energy program.

1. Output. We expect the plan, excluding the gasoline tax, to have no significant impact on the growth of real GNP or upon unemployment over the next four years. We estimate that the effect will range from minus 0.1 percent to plus 0.1 percent on the annual growth of real GNP. The impact on real output is so small because the program changes the prices of energy products relative to non-energy products without changing the overall level of demand for goods and services.

If the gasoline tax is triggered every year, it would have a slight contractionary effect over the period 1977 to 1981. Our analysis indicates that, taken by itself, it would tend to lower the annual growth rate of real GNP by somewhere between 0.0 and 0.2 percent. This results from a projected reduction in vehicle miles driven, which extends the life of the automobile stock and lowers automobile sales.

2. Prices. The major foreseeable impact of the program on the economy as a whole is the effect of the increased prices for petroleum, petroleum products and natural gas. The first effect of the higher prices, as we learned in the 1973-74 period with the OPEC price increase, is to drain off purchasing power from consumers. The resulting decline in real income leads to a reduction in consumer purchases of other goods and services. Should these cascade through the economy as a whole, there would be a reduction in total output and employment.

In the President's program, we have counteracted this effect by providing that the increased revenues of the wellhead and gasoline taxes be offset (or "recycled") by reductions in other taxes or increased transfer payments.

Because of the offsets, the total Federal taxes (net of transfers) will be unchanged, and the real incomes of consumers will remain unchanged, or will increase slightly. Therefore, the potential decrease in consumer expenditures will be avoided. Over the next two years, the only major price-raising aspect of the program is the wellhead tax on crude oil, which comes at the beginning of 1978. After 1978, there are additional increases in the wellhead tax, conservation taxes on large users of oil and gas, and possible gasoline taxes.

As a result of these measures, and without the gasoline tax, from 1977 to 1979, we expect that the annual rate of inflation would be 0.3 to 0.4 percent higher with the program than without it. In the subsequent two years, the price impact under the program would be smaller, with an increase in the annual rate of inflation of between 0.1 and 0.3 percent.

It would be fair to ask, why do we accept an energy plan which is inflationary? The answer is that the most important part of the plan is conservation, and that to make conservation effective

we must raise oil and gas prices so that consumers will reduce their consumption. We have been postponing this unpopular consequence of the new era of expensive energy, but we can no longer bury our heads in the sand: energy prices must go up. The higher prices are, however, a one-shot adjustment. They have been phased in at a pace consistent with our twin goals of conservation and maintaining a healthy economic recovery. We hope that no one will mistake the one-shot adjustment for an inflation caused by excess demand for goods and services.

3. Investment. The provisions of the energy plan contain a number of measures that affect the outlook for investment. There are some sectors of the economy in which the plan will result in additional investment, and others in which investment will be decreased.

We expect that the recent, relatively low levels of investment in new capacity on the part of electric utilities will continue. The reason for this is that the peak load provisions of the energy plan, as they are implemented by State public utility commissions, will allow electrical utilities to flatten the peaks and raise the troughs of electricity consumption, reducing the need for new capacity. By smoothing loads

the same electrical energy can be produced with less generating capacity. We must emphasize that this development is one which should be encouraged, as it implies a much more efficient utilization of our capital stock, and lower costs of electricity.

In addition, as we will show below, industries which are energy-intensive will find their costs and prices increasing faster than average. Growth in these industries may be slowed, and investment reduced.

On the positive side, there are a number of areas in which investment will be encouraged. Consumers have very strong incentives to insulate and weatherize their houses, and we expect a strong increase in this sector. Similarly, there will be a considerable increase in expenditures on facilities to produce, transport, and cleanly burn coal. These will be induced by conservation taxes on oil and gas, rebates and investment tax credits on coal conversion equipment, and more favorable relative prices of coal in general. Industry generally will be given an additional tax credit for investment in energy saving processes and equipment.

Summing all these factors, we anticipate that the positive impacts of the program will outweigh the negatives during the early years. For the period through 1980, we expect a net stimulus to investment to be in the range of from \$0 to \$2 billion a year. After 1980, however, the positive impacts may taper off as conservation expenditures stabilize while other types of investment, especially the investment by electric utilities in new capacity, begin to decrease.

4. Imports. One of the major goals of the program is to reduce imports of oil and gas. According to the projections of the White House Office of Energy Policy and Planning the program should reduce imports by approximately 4-1/2 million barrels a day in 1985. If by 1981, the program cuts U.S. oil imports by 1 million barrels per day, expenditures on foreign oil will be reduced by \$6 billion a year. In effect, we can be spending \$6 billion more on domestically produced goods and services -- such as coal and home insulation -- and \$6 billion less on foreign oil. As a consequence, GNP will rise.

5. Potential Output. It should be noted that the effects on output discussed up to this point refer to the impact of The Energy Plan on the overall demand for goods and services. Our analysis indicates that the impact on overall demand will be essentially zero. We recognize that the projections are subject to a wide margin of error, as in all exercises of this nature. But it is not essential that our projections be accurate to the last decimal point. If the economy is off the desired path, we will recommend midcourse corrections.

The discussion about the short-run macroeconomic consequences can, however, be quite misleading. The purpose of the plan is not to undermine the recovery -- quite the contrary. A sound energy policy will ensure that we need not curtail the output of our factories and compel our workers to remain idle to restrain oil imports -- surely the most wasteful form of restraint of all that have been suggested. It is designed instead to lay the foundation for a smoother, more secure, sustainable, less risky, acceptable, and more efficient economic growth over the coming decades.

- . Smoother, because the inevitable transition from oil and gas will start before the last moment.
- . More secure, because the energy will come from reliable sources.
- . Sustainable, because it will be based on resources which are abundant.
- . Less risky, because the economy's vulnerability to "oil shocks" will be reduced.
- . Acceptable, because we will make a transition to fuels and utilization processes which are relatively clean and reduce dangers of degradation or proliferation.
- . More efficient, because the price of our scarcest energy resources -- oil and gas -- will be priced at levels which more closely approximate their true value.

While it is extremely difficult to quantify these considerations in terms of real income, it must be emphasized that the purpose of the Energy Program

is to increase, not diminish, the well-being of the American consumer.

We have been asked whether The Energy Plan will lead to a loss in the productivity of our economy. This would be true only if it is believed that the true cost of oil and gas will return to a much lower level than its present level.

More important, however, is what has happened to productivity over the last three years. In general, after correcting for cyclical movements, the economy's productivity grows at a fairly steady rate, immune to microeconomic shocks. The one major exception of the postwar period is the "oil shock" which is estimated to have lowered productivity by 2 percent in 1974. Only by putting our growth path on a more secure basis can we reimmunize our economy to such shocks.

Coal conversion as a cornerstone for the medium-run.

In 1976, crude oil and natural gas constituted 74 percent of energy consumption, yet most analysts predict that this share must fall drastically by the

end of the century. The National Energy Plan expects that if the President's program is enacted the share of oil and gas would fall to 59 percent of total consumption in 1985.

The transition from an economy based on oil and gas requires that we use alternative fuels which are abundant, clean and economical. For the rest of the century, the only large-scale alternatives to oil and gas are electricity and coal. The form of coal conversion will differ between industries, whether it is direct burning, gasification, or--around the turn of the century--liquefaction, or in the next century some undreamt-of process.

Conversion would go on in any case, but the process is slow, costly, and difficult. More important, given the fact that we are subsidizing imported oil and holding oil and natural gas prices below their replacement cost, unless we change the present price structure we will actually impede conversion to alternative fuels.

We have received many questions about the coal conversion program. What will it cost? How would it work?

How fast will it work? Will it work? What I would like to do with you is to explain the major provisions of the coal conversion program, then to show how it gives powerful market incentives for industry to convert. Finally, I will suggest that if we do not take strong policy measures such as those the President suggested industry will definitely not have incentives to switch from oil and gas to coal.

The simplest way to see what will be the effect of the coal conversion program is to take a few products and show how they will be affected by the program.

I will go through some illustrative calculations to show you how this process works. It must be emphasized that--although the exact figures I will use are as carefully compiled as is possible given the constraints of time and availability of data--they are only order of magnitude estimates rather than exact predictions.

Sections 1501 to 1503 of the proposed National Energy Act establish a system of taxes on industrial and utility

uses of oil and natural gas. These taxes are designed to assure that industry pays the true cost to the Nation of oil and gas instead of the subsidized prices currently paid. In addition, it provides for rebates in the form of tax credits to industrial users of oil and gas who invest in "alternative energy property." Thus, the legislation penalizes the consumption of our increasingly scarce oil and natural gas resources. As much of the costs to a firm of converting a plant to coal operation would qualify for the credit, it encourages the use of our abundant coal resources.

In 1975, American industry paid an average of about \$1.40 per million BTU (all figures are in 1975 dollars) for oil and natural gas. This is well below the current world price of imported oil, currently about \$2.50 per million BTU for distillate fuel oil (inclusive of transportation costs and tariffs). By 1985, with the proposed industrial oil and gas taxes, the cost of the same amount of oil and natural gas to large users will rise to about \$2.70 per million BTU. Therefore, firms that choose not to convert their operations to the use of coal or some other alternative energy source will experience real energy costs in 1985 that are almost double those in 1975.

On the other hand, if industrial users of natural gas and oil choose to make the necessary investments to convert to coal use, their unit energy costs would be significantly reduced in 1985. After accounting for the fuel cost of coal and the annualized capital costs of conversion, adjusted for the tax credit or rebate, we estimate the cost of the equivalent per million BTU of coal in 1985 to be around \$2.05 in 1975 dollars--41 percent more than the 1975 cost of oil and gas, but only 76 percent of the 1985 costs of oil and gas. We expect that the lower fuel cost of coal will result in a substantial shift of energy consumption toward coal. According to The National Energy Plan, the program will lead to approximately five quadrillion BTU of coal conversion more than would otherwise occur.

These higher costs of energy will, of course, result in higher costs and prices for industrial products. The extent to which an industry's price is affected will depend upon both the increase in costs, the importance of oil and natural gas in the industry's production process, and the extent of conversion in the industry. To illustrate these effects we have

estimated the cost impacts on selected major products first assuming conversion does not occur and then assuming conversion occurs with the tax credit on coal conversion capital costs.

Let me say a word about the calculations. These estimates calculate the effect on the cost of the output of individual products using the technique known as "input-output analysis." It is important to understand how this works: we cannot simply ask, how much oil and gas does the apparel industry buy, and figure the effects on clothing by this route. We must take into account the fact that the apparel industry buys inputs from the textile industry, whose costs also will be affected by a rise in oil and gas prices. Similarly, textiles buy some cotton, which has fertilizer, and on and on. By using input-output analysis we can ask how much oil is there in a shirt, tracing it all the way back through the system.

There are also a number of technical assumptions which go into the analysis, on which there is a large technical literature. In addition we have been forced to make a number of simplifying assumptions. I must stress, however, that without such assumptions I simply could not ask, how will individual products be affected? and what are the incentives for conversion?

The products presented in Table 1 below fall into two categories--large or intensive users of oil and natural gas and non-intensive users of oil and natural gas. For products in the former category, expenditures on oil and natural gas are high relative to the market value of the goods they produce. Among these energy-intensive products, price increases by 1985 will be significant in the case of no conversion. For illustrative purposes we assume all oil and gas is subject to the conservation taxes, and that all can be converted. In the chemical industry, for example, prices in 1975 dollars would rise by 11.2 percent between 1975 and 1985 if no conversion took place. Food and kindred products would rise by 2.3 percent in this case.

The last column in Table 1 shows the effect on product prices if all firms convert all their oil and gas use to coal and receive the proposed rebate. As can be seen in the case of conversion, cost increases are estimated to be only half of what they would be with no conversion. For chemical products the cost increase would be cut from 11.2 to 5.5 percent while in plastics the rise would be 3.7 instead of 7.5 percent.

TABLE 1.

ILLUSTRATIVE CALCULATIONS OF REAL COST CHANGES,
1975 to 1985, SELECTED PRODUCTS, WITH THE
PRESIDENT'S PROGRAM

[Percent change, 1975 prices]

<u>Industry</u>	<u>No Conversion to Coal</u>	<u>Conversion to Coal</u>
<u>Large or Intensive Uses</u>		
Food and Kindred Products	2.3	1.2
Chemicals, selected chemical products	11.2	5.5
Plastics, synthetic materials	7.5	3.7
Stone and clay products	3.7	1.8
Fabric, yarn, thread	3.7	1.8
Paper, allied products	2.7	1.3
<u>Non-intensive Uses</u>		
Footwear, other leather	1.5	0.8
Materials handling equipment	1.4	0.7
Office computing, accounting equipment	1.5	0.7
Radio, television communications equipment	1.1	0.6
Electronic components, accessories	2.0	1.0

A second category of products represent non-energy intensive products, i.e. they have expenditures on energy that are low relative to the value of the goods they produce. As Table 1 illustrates, cost increases for the goods produced by these industries are estimated to be much lower, on the order of 1 to 2 percent without conversion. As in the energy-intensive industries, expected price rises are much lower if conversion occurs.

To see why the President's program is necessary, we next examine what happens to fuel and product costs, assuming the program is not adopted. Without the program we estimate the 1985 price (again in 1975 dollars) per million BTU's of oil and natural gas to be about \$1.80. The comparable 1985 price of converting to coal would be around \$2.50 per million BTU's. Without the program, an industry would rather fight conversion than switch.

Table 2 shows exactly the same calculation as in Table 1, except the former assumes the President's program is not passed.

TABLE 2

ILLUSTRATIVE CALCULATIONS OF REAL COST CHANGES,
1975 to 1985, SELECTED PRODUCTS, WITHOUT THE
PRESIDENT'S PROGRAM

[Percent change, 1975 prices]

<u>Industry</u>	<u>No Conversion to Coal</u>	<u>Conversion to Coal</u>
<u>Large or Intensive Uses</u>		
Food and Kindred Products	0.7	1.9
Chemicals, selected chemicals products	3.3	9.3
Plastics, synthetic materials	2.2	6.2
Stone and clay products	1.1	3.1
Fabric, yarn, thread	1.1	3.1
Paper, allied products	0.8	2.3
<u>Non-intensive Uses</u>		
Footwear, other leather	0.5	1.3
Materials handling equipment	0.4	1.1
Office computing, accounting equipment	0.4	1.2
Radio, television communications equipment	0.3	0.9
Electronic components, accessories	0.6	1.7

A comparison of Tables 1 and 2 reveals an important fact: without the programs the increase in real product prices in these industries is expected to be higher if firms choose to convert to coal than if they continue to consume the Nation's scarce oil and natural gas resources. For chemicals, without the program real costs are expected to rise 3.3 percent by 1985 if conversion does not occur, compared to an increase of 9.3 percent if conversion does occur. Similar results hold for other industries.

In short, the National Energy Plan's system of taxes and tax credits on industrial energy consumption is designed to encourage strongly the use of coal. It uses market incentives as a way of ensuring that the medium-term objective of coal conversion is attained.

What's the Rush?

Finally, I would like to turn to a question that has been on the minds of many thoughtful people: What is the urgency of the energy program? Why is the President asking sacrifice? And why now?

There are really two parts to the answer to these questions. First, the economy of the United States is becoming increasingly exposed to future "oil shocks," and this exposure must be reduced. Second, the sooner we act, the smaller are the economic costs of converting.

First, let us ask what will happen if we do not implement an effective Energy Program quickly. According to The National Energy Plan, without the initiatives the share of our energy that we import will rise from 19 percent in 1976 to 24 percent in 1985. This is not poetic license. In a recent review of five medium-term projections for 1990, I calculated that on average they predicted no fall in the share of imports even with strong policy measures. With the measures the President has proposed, The National Energy Plan projects that we will reduce our import dependency to about 14 percent of energy consumption. If we do not reduce our oil consumption now but let oil exporters reduce it for us in the mid-1980's by a sudden price rise, we could easily relive the history of the 1970's.

It is tempting to try to paint a lurid picture of future catastrophes. This has the aura of unreality, so I will approach the problem differently. It is clear that over the next four years we will be more dependent than we were over the last four years. But let us simply remind ourselves of what happened over the last four years:

In 1973, a short oil embargo against the United States curtailed millions of barrels of imports. According to one study, this led to a loss of \$20 billion of GNP in 1974.

In 1973-74, oil prices quadrupled, sending the world economy into the worst recession since the Great Depression. According to the last Council of Economic Advisers, the United States has produced \$375 billion less in output in the 1974-76 period than our potential GNP. The economy will probably not regain the level of potential output until the early 1980's.

In the winter of 1977--not that severe a winter, incidentally--the cumulative effects of the natural gas shortage led to the emergency and, at the peak, nearly two million workers were laid off.

In 1976 we spent \$32 billion for imported oil, while in the first four months of 1977 were running almost 50 percent above the same period last year. Our oil imports contribute to a significant imbalance in the global balance of payments position.

What does the next decade portend if we do not act swiftly and decisively? I do not pretend to know, but I would simply note that unless we act our position will almost certainly become more exposed. The sacrifices and structural changes asked for by the President pale beside the enormous and unforeseeable risks we run if we do not act.

Why not wait a bit longer? It is generally acknowledged that the transition from an economy based largely on natural oil and gas is inevitable. If we plan for the transition now, it will be cheaper than if we wait until the last minute.

We are today building capital equipment which will last anywhere from ten to fifty years. In some cases, as in automobiles, it is essentially impossible to "retrofit" the capital to make it more fuel-efficient after it is built. Therefore, if we are to proceed on a trajectory with a lower growth rate of energy use for the 1980's and 1990's, we must start to build more efficient capital equipment today.

Putting this proposition in another way, we might ask how painful or costly it is to reduce energy consumption. From all we know about technology and economic behavior, it is many times more painful to reduce energy consumption immediately than over a long period of time. Take residential heating as an example. The only way that we can reduce energy use over night is to turn the thermostat down--to freeze in the dark. In the medium run, as insulation occurs, we can heat with less fuel. In the long run as houses with higher thermal integrity are built, we can reduce energy consumption by 20 or 50 percent per dwelling without reducing the internal temperature 1 degree. It requires simply somewhat modified design and more costly construction.

It is hard to know how to quantify the timing factor, but the results of a recent survey of the literature by Lester Taylor of the University of Arizona suggests that the short-run costs or discomfort of cutting energy consumption may be from 2 to 6 times larger than the long-run costs.

Summary

To summarize the major points:

- . The Energy Plan is designed to lay the foundation for an economic growth path that is based on energy supplies which are secure, clean, and economical. At the same time, the taxes and rebates are designed to minimize any negative impact on the economy.
- . One cornerstone for reducing consumption of oil and gas is the coal conversion program. By raising oil and gas prices to their cost to the Nation -- and using some of the tax proceeds as rebates for

coal conversion--powerful incentives will be in place for industry to increase its use of coal.

If we are to ensure an orderly and efficient transition from the era of cheap oil and gas, we must act now. Failure to do otherwise would increase our exposure to "energy shocks" and increase the costs of transition at that point when delay is no longer possible.

Mr. DINGELL. You have done very well by the committee, and we certainly thank you for your kindness to us and your very helpful testimony.

The Chair will recognize members for questions now.

The Chair recognizes the gentleman from Texas, Mr. Krueger.

Mr. KRUEGER. Thank you, Mr. Chairman.

Thank you, Mr. Nordhaus for your testimony.

I am wondering, Mr. Nordhaus, whether the Council of Economic Advisers is responsible for some of the figures we were just given by Mr. Schlesinger or whether you plead innocent of those figures?

Mr. NORDHAUS. I heard probably 1,000 figures in the last hour and a half, Mr. Krueger.

Mr. KRUEGER. I was thinking particularly of the imaginative figures we had with regard to cost of deregulation, \$120 billion. Did that come out of the Council of Economic Advisers, \$120 billion by 1985 in net producer revenues?

Mr. NORDHAUS. No. We were not the source of origin of those numbers. However, I would like to suggest those must be the right order of magnitude.

Mr. KRUEGER. I think we will get the assumptions on them later, and I think that has already been requested in the record. I was just wondering whether the Council would also have any forecasts since, current producer revenues for interstate gas are \$5 billion and the Department of Energy has a \$10 billion budget, if we could assume a rate of growth comparable to the Department of Energy, whether we could not expect that the Department of Energy, by 1985, would have cost the American taxpayers a great deal more than \$120 billion.

Mr. NORDHAUS. I think on budgetary questions I will defer to OMB and the Department itself.

Mr. KRUEGER. I thought we would find a graceful maneuver; that is fine. I should like to ask with regard to insulation, which is one of the expectations of the Carter proposal, it's my understanding that currently 80 percent of the insulation comes from fiberglass, and we

have received testimony from people who manufacture fiberglass insulation that there are now only four companies in the United States that manufacture fiberglass. Two of these were shut down at least for part of the time last year because of the natural gas shortages.

I am wondering whether the administration has any plans on how to deal with the supply constraints on fiberglass, given the fact that we have had supply constraints because of energy shortages in the past, and the administration bill gives no allocation authority, as I understand it, to the administration to allocate gas from one industrial use to another.

Mr. NORDHAUS. On the fiberglass question, we did spend some time during the first 90 days of this administration explicitly considering what is going on in the fiberglass industry.

As you probably know, the recession which I referred to earlier led to considerable recession in the home insulation industry. In fact, much of the capacity utilization there was even lower than American industry as a whole. The reason, of course, being that most of insulation—I don't know the exact number, I guess it would be in the order of 75 percent of the insulation—is used in new construction, and since the housing starts and the construction were very depressed, the industry itself was quite depressed.

This is true as late as 1976, and I would suspect part of the shutdowns were simply due to reallocation of production among different plants, although I don't have any data on that.

I heard of no stories on inability of the construction industry to get materials of that kind. There have been other shortages mentioned, but that is one that has not been mentioned to me. So I think the major point is that there is ample room at the present time for retrofitting houses. It is much less fiberglass intensive than new construction, and there appears to be ample capacity for the next couple of years.

There are also a number of plans to expand construction. My understanding is, unlike the energy industry, the lead time for construction of these plants is in the order of 18 months.

Mr. KRUEGER. If I may get a question in before my time runs out, that doesn't concur with the testimony we received; I would just like to pose one more question, and that is the Carter proposal forecasts a total net energy use in this country of 40 million barrels a day of oil equivalent by 1985. As I look at the Carter proposal, I only find them coming up with something like 30 million barrels a day of oil equivalent energy sources, and I am wondering what we do with the gap?

Mr. NORDHAUS. Those are not the numbers that are contained in the National Energy Plan, and I refer you to page 96 of the National Energy Plan. In 1985, with the plan, it's expected that you get 46.4 million barrels of oil equivalent a day, with imports being 6.4 million barrels of oil equivalent per day. So those are the numbers, in fact, I refer to in my testimony.

Let me say on those particular numbers, the Council did have a considerable discussion and input, and I think we are fairly confident that those are good order of magnitude estimates.

Mr. KRUEGER. Would you feel that the increase in coal production of 84 percent by 1985 and of nuclear production of 380 percent by that time are realistic?

Mr. DINGELL. The Chair observes that the time of the gentleman has expired, and you may answer the question.

Mr. NORDHAUS. Unfortunately, the end of that sentence did not reach my ear.

Mr. KRUEGER. I wonder whether the increases between 1976 and 1985 of an increase in nuclear production of energy of 380 percent and coal production of 84 percent are, in your judgment, realistic?

Mr. NORDHAUS. I don't pretend to be an expert on either of those industries. My understanding is the nuclear projections are essentially plants on order or under construction, and I think the real question there is whether there will be slippage, but that is a question I think you should address to the electric utilities.

On the question of coal, I think there are a number of uncertainties on both sides, that certainly the numbers projected are below the technological capabilities of our economy. On the other hand, there are a number of measures which influence that, in particular environmental questions, transport, and so on. We looked at that earlier, and those look to be a good order of magnitude estimate, but whether you are going to reach that goal by 1984 or 1986 or 1985, I certainly couldn't testify one way or the other.

Mr. DINGELL. The time of the gentleman has expired. The Chair next recognizes the gentleman from Colorado, Mr. Wirth.

Mr. WIRTH. Thank you, Mr. Chairman.

First, Mr. Nordhaus, are there any other Nordhauses the committee ought to know about?

Mr. NORDHAUS. I don't know what you mean by know about. I could name about 10 more, but I think for this purpose—

Mr. WIRTH. Any other brothers?

Mr. NORDHAUS. No more currently in this city. All of my family is arriving next week.

Mr. WIRTH. That is a very impressive display of family unity and talent, I must say.

Let me ask you to start with the statement on the bottom of page 252, where you talk about raising oil and gas prices to their cost to the Nation. We might just talk a little bit.

How do gas prices under the President's proposal get raised to their cost to the Nation? I assume you mean replacement cost by that.

Mr. NORDHAUS. That is correct. That is one of the most explicit things in the bill. The price of natural gas to industrial users will be essentially set by the gas conservation tax, the boiler tax as it is sometimes known. That tax will be set at such a level that the acquisition costs for natural gas by large users will be on a Btu basis equivalent to the price of distillate. Going back one step, what sets the price of distillate in this program? Because of the combination of wellhead tax and other taxes, the price of distillate is certain to be at or maybe even slightly above the world price level. So I think there is no question that from the user point of view—I want to emphasize from the user point of view—the price will be at approximately the replacement costs in terms of imported distillate.

Mr. WIRTH. Why not, say, both on oil and gas, why not just charge the replacement costs to that industrial user, and then tax back what you might feel is a windfall?

Mr. NORDHAUS. I think these are equivalent, Mr. Wirth. I think this may be slightly easier to administer, but not being in FEA I couldn't testify on that. But from an economic point of view, which I can testify to, they are essentially equivalent.

Mr. WIRTH. Doesn't the approach of charging the tax, which gets passed on whether you tax it at the front or the end, doesn't that have the same economic impact as was suggested by Mr. Schlesinger that decontrol would have on the consumer?

Mr. NORDHAUS. It does, with one major exception. Here I would like to speak to the major economic consequences of using taxes which are recycled versus market clearing prices as a way of getting those user prices up.

Mr. WIRTH. Let's take the latter, though, the taxing at the end. In that, you would charge the replacement cost and then tax it back.

Mr. NORDHAUS. Let me just explain: If you look at current prices of oil and gas, versus what are estimated to be replacement costs, the current prices are on the order of \$40 billion lower than the replacement costs, that is for both oil and gas, and about two-thirds of that is natural gas.

Now, the problem is, of course, there are many marginal decontrol schemes between imposing taxes and having complete decontrol. I think there are no advocates around or very few for complete decontrol of old and new oil and gas.

Consider the \$40 billion of rents that would accrue to someone, if the replacement cost of all oil and gas were set at the world price level. The problem from such a large price increase from the macro-economic point of view, is that the rents flow into corporate profits, and, as we saw in the 1973-74 era, the propensity to consume out of corporate profits is relatively low.

Therefore, we would be headed for a repeat, on a smaller scale, of the 1973-74 recession. So I think—without even getting into equity arguments, which we might also feel strongly about—from the macro-economic point of view there is a very important difference between the two approaches.

Mr. WIRTH. I think I understand that and I am sympathetic with that in terms of not wanting to bludgeon the economy as we did with the quadrupling of oil prices. But I am concerned about the need to make a distinction between what is defined as between new and old gas, and new and old oil, for the purposes not of providing that kind of massive windfall but providing the kind of a balance we are looking for between production and the replacement cost impact on consumption.

Mr. DINGELL. The time of the gentleman has expired.

The gentleman can finish his question.

Mr. WIRTH. Thank you very much.

This morning Mr. Schlesinger talked about the administration's offering exemptions for hard to get natural gas versus what would be, I suppose, not hard to get new natural gas. Do you have any estimate as to what the difference in volume is or percentages that we are talking about between hard to get new natural gas and not

hard to get new natural gas, and following what the assumptions that Mr. Schlesinger was referring to this morning.

Mr. NORDHAUS. I think there may be estimates, not using the same labels as you have used, of the increase in gas which is at the higher price level from, let's say, frontier gas, deep formations, tight formations, geopressurized on the one hand, and new gas which receives approximately \$1.75. I think there are estimates, but my impression is in both cases for the next couple of years they will be relatively small. We could try.

Mr. WIRTH. They are very small.

Mr. NORDHAUS. My impression is that new production is going to be relatively small, but I can get my staff to track that down and try and get an answer.

Mr. WIRTH. If you could, I would appreciate it.

Thank you very much, Mr. Chairman.

Mr. DINGELL. The time of the gentleman has expired.

The Chair recognizes the gentleman from Michigan, Mr. Stockman.

Mr. STOCKMAN. I would like to follow up on the discussion, because at page 14 you indicate that the price per Btu would be about \$2.70 when the oil or gas is taxed up to the world price through the plan, either taxed up or priced up, and that the current price is \$1.40 on average to the industry per million Btu's. By converting to coal the average price to the user is going to be \$2.05.

Mr. NORDHAUS. Right.

Mr. STOCKMAN. I am wondering, are you responsible for those calculations, your shop, yes or no, and if you are—

Mr. NORDHAUS. Absolutely, I stand by them.

Mr. STOCKMAN. Then we can pursue that, good.

Mr. NORDHAUS. There is a typographical error on line, I think it's 10 of page 14, and that should be 46 percent instead of 41 percent.

Mr. STOCKMAN. Fine. So I would assume then that all of the numbers you have in table 1 are calculated on the basis of the \$2.05 for conversion to coal, and the \$2.70, which would be the taxed price or priced up price for oil and gas.

Mr. NORDHAUS. That is correct.

Mr. STOCKMAN. What we have heard in the testimony thus far, I assume the \$2.05 is based on direct conventional gas combustion, it is not based on coal gasification because any figures we have heard are in the range of \$3 to \$6 per million Btu. What we have heard in the testimony I think is opportunities over the next 10 or 15 years for direct conventional combustion in industry are far more limited than your assumption. The only place that can be successfully done are for very large boiler users and as a result it seems to me you ought to blend into your figures these two factors:

One, that if you are displacing oil and gas with conventional oil and gas, some of that displacement is going to be direct coal combustion, and we can argue the \$2.05 figure but some of it is going to be converted gas or LNG and it seems to me you need to rule that in.

Secondly, I have gross doubts about your \$2.05 figure because as I read what you have indicated here, you are only counting the cost of conversion of the boiler itself, minus any tax credits, and the fuel cost or the fuel acquisition cost of coal.

I think there is much more to that than that. We have discovered you can't convert an oil or gas boiler to coal; you have to replace it, and you are going to have a much higher acquisition, plus in some cases you are going to be scrapping relatively new boilers, oil and gas, and that's an economic loss that has to be figured into the calculation.

Second, we have discovered you are going to have much higher costs for storage, and for space requirements for coal. In fact, the people from the boiler industry indicated to us last week that the storage space requirements and the use space requirements are on the order of 10 to 1 between coal and gas or oil fired boilers simply because you have to store the coal, and you have all of that space for the present combustion items, or machinery that you need, stokers and so forth, and again that is going to be a cost in a lot of industrial situations because they don't have the space available.

We have also learned you have much higher operating costs. The boiler people tell us a guy who has been running a gas or oil fired boiler for the last 10 or 15 years can't run a coal fired boiler simply because it's a totally different process that requires different kinds of knowledge and skills about the combustion process. So again you are going to have more people, higher paid people and more costs, you are going to have tremendous costs for SO₂ control, NO_x control and other emissions from the combustion process, and you are going to have tremendous disposal costs as well, because over the next 10 to 15 years we simply don't have the technologies that would allow for regenerative control or for fluidized bed combustion and so forth.

It seems to me that those are all costs to the user that he has to figure into the Btu that he is trying to convert into heat or work, and that you really haven't figured those into the \$2.05 figure, and that the numbers, therefore, that you have in chart 1 or table 1 are dubious at best, and probably irrelevant in the most likely case.

Do you have any response to that?

Mr. NORDHAUS. My major response is that I think what you have done is made a very good case for the coal conversion rebate provisions that are considered in the bill, and in particular in section 1502.

Mr. STOCKMAN I would accept that. But let me make a case for the unrealism of the \$2.05 figure.

Mr. NORDHAUS Let me carry on. The \$2.05 figure takes into account not the acquisition costs of the equipment that you have mentioned, which I think are quite considerable. In fact, we may have underestimated that, but I think something you have not factored into your analysis, unless I misheard you, was the fact that I think almost all of the items that you mentioned, with perhaps the exception of some of the building and the land, are eligible for the conversion credit for alternative energy property. In particular, let me remind you, that included for this coal conversion credit in section 1502, are coal fired boilers, boilers in general, facilities for conversion into low Btu gas and so on.

Now, let me explain a little bit more about how that works.

When an industry currently is burning oil and gas and will be paying the boiler tax upon them, according to the proposed legisla-

tion, the proceeds of the oil and gas boiler tax can be used to pay for conversion equipment into coal. So with the exception of land, and also the labor, that means that you get essentially a complete offset for the purposes of private calculation of the costs of this.

Now, we used a rather pessimistic or conservative assumption in these numbers, that there is essentially a 50 percent, equivalent tax credit due to the rebate provision. When you actually feed that through in the economic calculations, it means from a private point of view, not from the point of view of the Nation as a whole or the point of view of the Treasury, that the capital costs of conversion into coal are really quite small.

When you add together the rebate, the normal investment tax credit and the depreciation provisions, it isn't free, but it's very close. The capital costs of conversion are very small, and, in fact, the main thing that you would then start arguing about is what are the fuel costs, the transportation costs of the coal itself, in addition to the operating costs and the labor that is involved.

I am not going to the stake over the \$2.05 figure, and probably should have rounded to the nearest dollar because of the uncertainties about what equipment, coal prices, and technology are going to be in 1985. I think that it's the right order of magnitude.

I think what you have done, however, is emphasize that the second table, which shows what happens if we do not have the program, underestimates the conversion costs to coal and shows, in fact, how much less coal conversion we are going to have in 1985 than even the pessimistic assumptions of the National Energy Plan suggest.

In fact, if you mark those up a little bit, this means the cost of conversion is instead of two and a half maybe four times the cost of staying with oil and gas.

So to summarize, I don't argue with your basic assumption. We have used, in fact, a number on the order of \$6 billion of capital cost per quad of conversion costs. Many numbers I have seen are lower, some higher, but I don't think it really invalidates the basic conclusion that you need some strong measures to get industry off oil and gas.

Mr. DINGELL. The time of the gentleman has expired.

The Chair observes there is a vote on the floor. We have approximately 5 minutes to get over and vote.

Mr. Nordhaus, could you wait just a minute because the staff has a few questions, and I have a few questions and I think Mr. Brown has a few questions, and perhaps Mr. Madigan, who is also our colleague here, has some, and we should be back in about 5 to 10 minutes.

I apologize for having to go. We will return as quickly as we can.

The committee will stand in recess until that time.

The Chair should note that it is the Chair's intention to reconvene for the next panel of witnesses at 1:30 instead of at 1:00 o'clock. So the committee will be in recess for about 5 or 10 minutes while we run over and vote and come back.

[Brief recess.]

Mr. DINGELL. The subcommittee will come to order.

Mr. Nordhaus, we apologize to you for the delay. We recognize now the gentleman from Illinois, Mr. Madigan.

Mr. MADIGAN. Mr. Nordhaus, there have been various estimates given of the total revenue yield for the President's energy program.

In terms of taxes, as I understand the program, we are dealing with four things: A stand-by tax on gasoline, a crude oil tax, a gas guzzler tax on certain kinds of automobiles, and an incentive tax to help implement coal conversion.

One estimate for the total of those four taxes is \$140 billion annually by 1985.

Curiously enough, the total individual income tax payments to the Government in 1976 was \$140 billion. Should anyone advocate the doubling of the Federal income tax on individuals? I should think they would be condemned as advocating very inflationary action, and an action that would have severe economic impact, and severely impact upon the people on the low end of the income spectrum.

How is it that the same kinds of criticisms do not apply to the President's energy program?

Mr. NORDHAUS. I mentioned and referred to this in my oral remarks, but in the prepared testimony I said a couple of things about that.

I have a little trouble with the view that we are raising \$150 billion in new taxes. From an economist's point of view, I view it slightly differently.

The tax structure of the United States over the last 15 years has been one in which we have had considerably more reliance upon individual income taxes and on social security taxes. At the same time excise taxes and corporation taxes have declined as a share of the total Federal tax take.

We have on the books now certain tax laws; as you know, the administration has in progress a very comprehensive set of tax proposals which we are considering and which will be submitted to the Congress later this year.

The way I would like to view the energy tax legislation is that we are changing, to a certain degree, the way we raise our Federal revenues. We are now turning around the decline in the use of indirect taxation, which is now virtually zero on the Federal level, and are going to increase that over the next 8 years. We are going to lower personal income taxes by almost exactly an equal amount. So I don't find it helpful to say we are raising so much extra revenue. Rather I look at it as raising the revenues we need to pay for our Federal purchases through a different mix of the four different basic tax systems we use.

Mr. MADIGAN. If what you say is correct, you said we are going to lower individual income taxes by the same amount, and you used the figure \$150 billion.

Mr. NORDHAUS. That is a cumulative number.

Mr. MADIGAN. If the taxes paid by individuals through the income tax were \$140 billion last year, then did I understand you to say you are going to eliminate individual income tax payments?

Mr. NORDHAUS. I think the number you were using was more of a cumulative number, if I am not mistaken.

Let me just give you an example which would refer to the crude oil equalization tax, just to make it concrete. According to numbers

which have been worked up in the administration, we expect that the total revenues that will be raised by the wellhead tax in 1985 are on the order of \$10 billion for lower tier.

Mr. MADIGAN. May I interrupt?

Mr. NORDHAUS. Let me just finish. I want to make this point more explicit. Adding the \$2 billion for the upper tier, we have a total of both tiers of about \$12 billion. Now at the same time we are going to lower personal income taxes and raise transfer payments by almost exactly the same dollar amount. So what we are doing is raising excise taxes and lowering individual taxes. But, the total tax take of the Federal Government, due to this measure, will be almost exactly the same.

Mr. MADIGAN. The thing I have a problem with is the \$10 billion figure, because I have studies from three different associations that all come closer to \$50 billion. As a matter of fact, the low figure is \$49.4 billion in 1985 for the crude oil tax.

How can there be such a difference, a difference of \$40 billion?

Mr. NORDHAUS. I was referring only to the wellhead tax, Mr. Madigan. Now, there are other taxes that you would probably want to mention. One would be the boiler tax on oil and gas. The other one would be the standby gasoline tax.

Mr. MADIGAN. Isn't the crude oil tax the difference between the controlled price, the domestic price, and the world market price.

Mr. NORDHAUS. That is correct.

Mr. MADIGAN. By 1985 is it not possible that the world market price will be substantially more than it is in 1977?

Mr. NORDHAUS. Oh, no. I was just talking about some base line assumptions which went into our projections, which are that the import price would go up at essentially the same rate of increase as the GNP deflator. If, in fact, it goes up faster, as some forecasters think, then you would have a higher wellhead tax take. If it goes up slower then you would have a lower wellhead tax take.

Mr. DINGELL. The time of the gentleman from Michigan has expired.

The Chair recognizes the gentleman from Ohio, Mr. Brown.

Mr. Nordhaus, I apologize; had you completed your answer? I am going to call time on the Member, but you have time to complete your answer.

Mr. NORDHAUS. I think I got the major points.

Mr. DINGELL. All right. The Chair recognizes the gentleman from Ohio, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

Mr. Nordhaus, the FEA and USDA have variously estimated that the cost of energy and products of agriculture, food and fiber products, is somewhere between 6-1/2 percent and 8-1/2 percent.

If you had a 100-percent increase in these products, the price presumably of the cost of food would go up, say, to as high as 108-1/2 percent. That would be a scenario, for instance, where there might be some very sharp increases in price as a result of decontrol of the cost of these energy inputs. A sharp reduction in production would result, if we run short of energy in agricultural areas.

That is a real problem that we faced in the question of fertilizer and natural gas, which is going to be more inflationary with

adequate supplies of natural gas at a decontrolled prices, or an inadequate supply of natural gas. For instance, you can't produce a sufficient amount of food in this country or you can't make the glass to employ the people who work in the glass industry or some of the other needs for energy that cannot be changed.

Mr. NORDHAUS. I would think that to be the kind of question that is difficult to answer, because it involves things that are both difficult to measure and intangible, but I would guess that most analysts would feel that the most costly possible form of energy problem is the curtailment of a critical industry, or critical product.

So I have no hesitancy to say that one of the cornerstones of this plan is to make sure that people who really need fuel supplies have them.

If the cost of that is that they have to pay a slightly higher price, then within reason, and making sure there are no windfalls, again, then we are willing to pay that.

Mr. BROWN. Did I mishear the comment made by Secretary Schlesinger, that if you decontrol the price of natural gas and natural gas would increase, it impacts on the economy by \$120 billion? Did I mishear that?

Mr. NORDHAUS. We had some earlier discussion of that, I don't know if you were here, Mr. Brown, with other members of the committee, and I will be glad to repeat the comments I made at that time.

Mr. BROWN. Don't repeat them. Just answer the question as to whether or not I misheard that. Is that an estimate that you have made, that \$120 billion would be the cost of deregulation of natural gas?

Mr. NORDHAUS. I heard the same number and as I said earlier----

Mr. BROWN. Can it be justified?

Mr. NORDHAUS. I think so, yes.

Mr. BROWN. Could you provide that for the record, the justification?

Mr. NORDHAUS. I will tell you what I will do; I guess Mr. Schlesinger was also asked if he would provide that. I will make sure our staff looks and checks those numbers very carefully.

Mr. BROWN. Yes. I wish you would be sure to send that to me separately, because I am just absolutely startled at that figure, and feel that it must mean deregulating all of the previous contracts of natural gas up to a current market price, and, of course, nobody has proposed that, which I know of, although I must say that the administration program is somewhat more generous than the legislation suggested by Mr. Krueger and myself in that regard.

We were going to freeze the price of current contracts.

Could you tell me why the administration chooses to go with taxes on processed fuels?

Mr. NORDHAUS. Could I just respond?

Mr. BROWN. If I can go ahead and ask the question, could you tell me why the administration chooses to go with a tax on processed fuels that cannot be reduced, can only be passed on?

Mr. NORDHAUS. Yes. I think that is very easy. The easiest way to see that is let's pretend just for the moment, just take a hypothetical example where you have an industry----

Mr. BROWN. Don't make it too long because I have other questions I want to ask.

Mr. NORDHAUS. Do you want any answers?

Mr. BROWN. Yes, but I would like to have them as brief as possible.

Mr. NORDHAUS. Give me 60 seconds to answer your question.

If you take industry that is using subsidized fuel, say an imported fuel at a price which is say \$2 or \$3 a barrel lower than the actual cost to the Nation—

Mr. BROWN. Let's take natural gas, because that is what I am concerned about. I mentioned the glass industry, and food processing.

Mr. NORDHAUS. Let me finish the example . . . then simply exporting that abroad. We are simply subsidizing consumption of our trading partners.

Mr. BROWN. Let's talk about domestic energy sources if we could. That is the area of my concern in terms of taxes on processed fuels.

Mr. NORDHAUS. Okay. From an economic point of view I think it's the same point, because when you are using fuel, it doesn't matter whether you use a barrel of oil or gas to produce whatever that product was. The marginal source today, I think everybody agrees, for energy use of oil and gas, is imported oil, and therefore, from the point of view of the Nation as a whole, we are paying the world price, \$13.50 in goods and services, but we are subsidizing that end use to producers. That is the economics behind why we think users should pay the true cost of oil and gas.

Mr. BROWN. So that everybody should have to pay more for the food, for instance, by placing an additional tax on processes in food production that use natural gas, but we should not pay full price for the production of that natural gas. That is where I am lost. You make the consumer pay; you add to his cost, but you don't encourage his supply, and if that results in the shortage that you said, it would be economically deleterious. Then you really present the consumer with the worst of both problems.

Mr. NORDHAUS. No, I think there are a number of steps in this. The first is in each process you would ask that users pay what is a replacement cost for the inputs they use—

Mr. BROWN. But that money is—

Mr. NORDHAUS. Whether labor or capital. Secondly, that will be passed on to consumers in the form of higher prices. But, third, the important point of the program is that if you are worried about consumers, we are rebating the proceeds so that low income individuals will actually have higher real income than before. And, fourth, because of the industrial tax on oil and gas, we are trying to ensure that we don't have the perennial curtailments in the natural gas supply.

Mr. BROWN. That is the part that is missing in the program. Why then, do we not encourage production with that, rather than face the consumer with the shortage of supply which will run up the cost of the product in addition to what is happening to the industrial tax?

Mr. NORDHAUS. There are two answers to that. One is that we think that in the time horizon to 1985, if you look at most of the

actual econometric, technical, and statistical work, the difference between the program we are proposing and a very generous, complete decontrol, throw-it-to-the-market—

Mr. BROWN. That is not proposed.

Mr. NORDHAUS. No, but that is the one where you get the most production incentive, I guess everybody would agree.

Mr. BROWN. No, I don't agree with that.

Mr. NORDHAUS. If you look at the difference between those two, it makes a fairly small impact on gas production by 1985. On the other hand, by raising the price to users, and particularly industrial users, we think you can get a fairly significant backing out of that market because of raising the price. Those are industries where alternative processes exist, where—

Mr. BROWN. Which is not what we are discussing.

Mr. NORDHAUS. That is what we are discussing because by freeing up the natural gas which is now used by industry, a large fraction of our gas, this will then make it available for high priority users.

Mr. DINGELL. The time of the gentleman has expired.

Mr. BROWN. Thank you. I want to remind the witness we are talking about processing fuels—

Mr. NORDHAUS. May I comment on this, because I think it is very difficult to separate out, the way Mr. Brown was, individual industries and individual processes. The economy is tied together through a number of different channels. If you free up the demand by having conversion or conservation in one industry, that essentially frees up resources for the economy as a whole, and I think that is the kind of conversion program we are looking for over the next 10 years.

Mr. DINGELL. The Chair recognizes Mr. Schroeder, of the staff, for questions.

Mr. SCHROEDER. Thank you, Mr. Chairman.

Mr. Nordhaus, you indicated in response to an earlier question that you weren't particularly concerned about shortages in the insulation industry as affected by the insulation provisions of the plan. The way you responded to the question suggested that perhaps you were concerned about other shortages. You didn't go into those, and I wonder if you could highlight, if there are concerns on your part that some shortages elsewhere in the economy might develop, what might those shortages be?

Mr. NORDHAUS. The concerns I had were just based on very informal reports I have had at the Council from builders around the country and in particular in areas where speculative fever is running very high. My understanding is that some builders have reported spot labor shortages, in particular for certain kinds of skilled labor. I was just noting that I have heard no report, so far, of shortages of fiberglass.

Let me amplify the remarks a little. If we think of what the implication of a shortage is, say, that we have 10 percent of our demand for retrofits in a given year which can't be met because of insufficient capacity, although I think that is something that is a shame, it is not a disaster. It simply means that our targets will be off by 1.2 months. I would like to have the capacity, of course, but I don't think it is a disaster if we are off one side or the other a little in some of the projections.

Mr. SCHROEDER. You indicated, also, I believe in the early part of your statement, that the total impact of tax collections and rebates would be roughly neutral in 1981. I think that was the year you made reference to. Perhaps I heard you wrong.

Mr. NORDHAUS. The comment I made was exclusive of the—just to make it absolutely clear—gasoline tax. Assuming it is not triggered, we expect that the impact of the program as a whole will be essentially neutral on the economy, plus or minus a tenth of a percent per year in the real growth of GNP.

Mr. SCHROEDER. By 1981, was that the target year you made reference to?

Mr. NORDHAUS. That was the terminal year of our forecast.

Mr. SCHROEDER. By that date certainly the oil and gas consumption taxes will begin to have substantial effect. I presume by your statement that your feeling is that most, if not all, of any tax credits or rebates to be gained by virtue of qualified investments in coal conversion would keep pace with those tax penalties?

Mr. NORDHAUS. No. In the first place, there are substantial coal conversion taxes in 1981. In fact, that is the major inflationary and contractionary force—

Mr. SCHROEDER. Do you have a rough value for that tax in 1981?

Mr. NORDHAUS. You want that net or gross of the rebate?

Mr. SCHROEDER. Gross.

Mr. NORDHAUS. I can give you net easily; gross will take me a second.

Let me answer the question, and I will give you that in a minute. So there is a significant effect on the rate of price increase from the industrial boiler tax.

I think, however, our assumptions overestimate the inflationary impact in two respects. The first is we did not fold into our forecast any incremental pricing estimates, and, as this committee knows, having studied that in some detail, that can make a whale of a difference in the actual outcome. In fact, a quick calculation would say if \$5 billion of those boiler taxes were removed by incremental pricing, that you would reduce the inflationary impact of the oil and gas taxes by 50 percent, and they would have a substantial lower impact on the rate of inflation.

Mr. SCHROEDER. Wouldn't it also, not to interrupt you—

Mr. NORDHAUS. The other conservative consumption was that business did not pass through the rebate fully into the lower prices.

Mr. SCHROEDER. You raise an interesting point. Isn't there a significant interaction between the incremental pricing of natural gas and the efficacy of the coal conversion program, the boiler tax, in that that money which would otherwise be a carrot for industrial conversion instead goes to producers of natural gas?

Mr. NORDHAUS. No, it goes to consumers. In no case does it go to producers.

Mr. SCHROEDER. In incremental pricing, the extra payment that the industrial customer has to make goes to the producer.

Mr. NORDHAUS. That is a very important point. Under the provision of the law, assuming the same quantity of gas flows, what it would mean is that you have the replacement cost of the gas you are now burning is x million dollars higher, that you would pass

that first through to industrial customers, and not through to residential customers, and the total take of producers and distributors of gas would be the same.

Mr. SCHROEDER. I understand that.

Mr. NORDHAUS. You redistribute the cost of the gas.

Mr. SCHROEDER. Let me give you two scenarios. One, no incremental pricing. The oil and gas consumption tax draws up the industrial price to some amount, all of the amount above the natural gas base price, basically stays in a Federal pool that the converting industrial owner can go after.

In the second scenario where the price is, let's say, 75 cents per Mcf higher, the amount of money that can be put into the pool and therefore the amount of money he can go after in the form of the tax rebate is lessened by precisely the amount he has paid incrementally for his natural gas. This incremental payment goes to the producer rather than to the tax pool.

So is there not at least, other goals aside, at least an apparent inconsistency between the goals of the coal conversion program and the effects that superimpose themselves on that program from incremental pricing of natural gas?

Mr. NORDHAUS. You are absolutely right but let me point out two factors that mitigate that. The first is if you look at the actual revenues that are projected for the oil and gas conservation taxes, the rebates that are being projected are slightly more than half of those, and this leaves in the order of \$5 billion, say, in 1981, of unused taxes, so to speak, that would flow to the Federal Government. So if you take the hypothetical example of a while back, that incremental pricing actually allocated \$5 billion more to industrial and \$5 billion less to consumers; then this would say there is none left over, but there is a little bit of a gap there between the revenues and rebates in our estimate.

Secondly, there is a fallback strategy if you started bumping that constraint of having insufficient taxes paid, and that is there is still a 20 percent investment tax credit in addition to the usual depreciation provisions. So obviously there is a tradeoff there, as in most things, but I think the most you could possibly lose is the difference between the 50 and the 20 percent investment tax credit in the worst case scenario.

Mr. SCHROEDER. One final brief question. The oil and gas consumption tax overlaps with the regulatory coal conversion initiatives in the ESECA amendments. Can you give us a sense whether you see any important economic interplay between the regulatory and the tax-incentive double-pronged attack on coal conversion?

Mr. NORDHAUS. I think there are a couple of things. First, the ESECA amendments essentially strengthen ESECA as it now stands to be allowed to use regulatory powers to nudge large users away from oil and gas. I think that is the basic point. And you might ask why do you want to use regulatory sticks in addition to financial carrots? The answer I would give, and I am sure this committee is probably fully aware of the general reason, is that industry has shown a certain reluctance to undertake certain regulatory measures when it did not pay them to do that. They have often found that a day or a year or a decade in court fighting

particular regulations was cheaper than to go along with a regulatory proposal and to convert.

I think those tables that I used in my prepared testimony show if, in fact, we don't have some kind of provision for getting oil and gas prices up and having some kind of rebate or credit for conversion that we are going to find that any regulatory measures to have large users convert are going to be fought tooth and nail. If the economic incentives are there, I think large users will go along. My understanding—I may be wrong—is that the FEA has had power to order utilities to convert, and my understanding is there hasn't been 1 megawatt converted under that law, so I think that is able testimony to the necessity of having carrots as well as sticks in this kind of program.

Mr. SCHROEDER. You have explained why you need the carrot in addition to the stick. But why do you need the stick if you have the carrot?

Mr. NORDHAUS. I think the reason is that in the case of large users there are a few hundred large users that you might want to target, and with those you can look carefully at the environmental aspects of the question, and at the economic questions. Let's take a simple case where on the private economic point of view it might be a very close call between conversion and not conversion, whereas from the social point of view there might be big advantages to having conversion. Management might take the easy route and not do anything. You might want to tip the balance in favor of conversion.

I would trust that the regulatory powers will be sparsely used, but I think they are necessary to make sure that the general thrust of the program to reduce oil and gas consumption in the industrial sector is pursued and effected.

Mr. SCHROEDER. Thank you. And thank you, Mr. Chairman.

Mr. DINGELL. Mr. Nordhaus, we thank you. You have been very patient, and we are grateful to you for your assistance.

The subcommittee will stand adjourned until 1:30.

[Whereupon, at 1:15 p.m., the subcommittee adjourned, to reconvene at 1:30 p.m. this same day.]

[AFTER RECESS]

[The subcommittee reconvened at 1:30 p.m., Hon. John D. Dingell presiding.]

Mr. DINGELL. The subcommittee will come to order. This afternoon, we have Dr. Alice M. Rivlin, Director, of the Congressional Budget Office, accompanied by members of her staff.

Doctor, if you would identify yourself for purposes of the record and your associates at the table, we would be pleased to receive your statement.

STATEMENT OF DR. ALICE M. RIVLIN, DIRECTOR, CONGRESSIONAL BUDGET OFFICE, ACCOMPANIED BY DR. RAYMOND C. SCHEPPACH, ASSISTANT DIRECTOR, NATURAL RESOURCES AND COMMERCE, DR. DAMIAN KULASH, DEPUTY ASSISTANT DIRECTOR, NATURAL RESOURCES AND COMMERCE, AND DR. RICHARD D. MORGENSTERN, PRINCIPAL ANALYST, NATURAL RESOURCES AND COMMERCE

Dr. RIVLIN. Yes, Mr. Chairman. On my right is Dr. Raymond Scheppach, Assistant Director for Natural Resources at the CBO.

On his right is Dr. Scheppach's deputy, Dr. Damian Kulash, and on my left, Dr. Richard Morgenstern, senior economist at the CBO.

Mr. DINGELL. Doctor, we have admired greatly your work over the years, and I want you to know how grateful we are you are with us. We are pleased you are here, and thank you for coming to assist us.

Dr. RIVLIN. Thank you, Mr. Chairman.

We have recently prepared a report on President Carter's energy proposals, which is being released today. Unfortunately, we don't yet have printed copies. They are at the Government Printing Office and should arrive momentarily, but this is a copy of the report. It is not extremely bulky.

Mr. DINGELL. Without objection, that will be inserted in the record.

Dr. RIVLIN. Mr. Chairman, I am happy to be with you today to comment on President Carter's energy proposals. In response to requests from committees in both Houses of Congress, the Congressional Budget Office has begun to examine and evaluate these proposals. Today we are releasing a staff working paper that provides a preliminary analysis of the proposed legislation. More detailed analyses of the President's proposals and alternatives will be made available to the Congress as soon as they can be completed.

Today I would like to touch briefly on five points: (1) the need for an energy plan; (2) the general orientation of the Carter plan; (3) the preliminary results of our analysis of the impact of the President's proposals on energy consumption; (4) the impact of the proposed plan on the economy; and (5) the distributional effects of the plan across households.

THE NEED FOR AN ENERGY PLAN

The need for a national energy plan arises from both immediate and long-run problems. The long-run problem is simply that the growth in consumption of oil and gas exceeds the growth in proven reserves—both domestic and foreign. Before long we will have to shift to new energy sources or face drastic reductions in our standard of living. The more immediate problem is that our imports of oil have increased substantially—from 3.5 to 7.3 million barrels per day between 1970 and 1977. The fact that almost one-half of the oil consumed in the United States is now imported creates national security risks and makes our economy highly vulnerable to outside shocks, especially because the supply and price of oil is largely dictated by an international cartel.

A major reason for the substantial increase in our dependence on imports is the current system of price controls on oil and gas that have kept the domestic price of these fuels artificially below world levels. Over the past 4 years, this regulatory system has served to cushion Americans from the dramatic adjustments in consumption and lifestyles that might otherwise have taken place due to the abrupt quadrupling of world oil prices by the OPEC cartel in 1973-74. It has also tended to encourage energy consumption and discourage the search for and production of new domestic resources—thereby further increasing our dependence on potentially unreliable foreign suppliers.

To reduce import dependence the President has proposed three major strategies:

Reduce the long-term growth in energy demand by imposing various excise taxes that would serve to raise the price of petroleum and related products to world or near-world levels. New regulatory standards are also proposed and special efforts are taken to reduce the growth in demand for gasoline.

Increase large industries' and utilities' use of coal instead of oil or natural gas by taxing their use of oil and natural gas. Regulations are designed to prohibit most new industrial and utility use of oil and natural gas.

Increase domestic supplies by reintroducing market pricing, or near-market pricing, for truly new energy supplies. Accelerated development of new energy sources, however, is not stressed.

In evaluating these overall strategies and the goals of the President's program, it is important to keep in mind several points. First, an important theme of the proposed program is that the transition to a less energy intensive economy is a long and complex process. Incentives established now to alter consumption and investment decisions regarding energy use will begin to yield significant savings within the next few years. But large-scale savings will not show up until the middle of the next decade and beyond. Of critical importance is the fact that most of the costs of such a program will be paid between now and 1985, while most of the benefits will occur beyond 1985.

A second major point is that the goals and energy savings incorporated in the National Energy Plan may not be fully achieved by the National Energy Act as introduced. While the administration hopes that the act will attain the stated goals, it recognizes that the hope may not be realized and that additional legislation or regulations will be required. Indeed, the administration seems to be viewing the energy plan in two steps, that is, this initiative and then more severe measures if this legislation does not reach the specified goals. Many of these more severe measures are included in the plan, but are not incorporated into the act.

The size of this potential gap between the energy savings of the plan and the act would depend significantly on a number of additional regulatory decisions, such as exemptions from mandatory coal conversion, over which the administration would have control. Strict enforcement would increase the likelihood of attaining the goals. Consequently, the commitment of the Administration to the goals is critical in determining the efficacy of the overall plan.

Finally, the President's proposals are highly interdependent. To a large degree, there is a "carrot and stick" philosophy. For example, the tax credits given to industry to encourage investments would be made more effective by the increase in petroleum and natural gas prices. Either of these two proposals independently might yield only marginal energy savings, but combined, the effect might be substantial.

CONCLUSIONS OF THE CBO STUDY

The CBO analyses to date have concentrated on five major sets of proposals in the administration's plan: Pricing of crude oil; pricing of natural gas; conversion to coal; automobile-related proposals; and tax credits for home insulation and solar heating equipment.

The administration estimates that altogether, these proposals would achieve a reduction in oil imports of approximately 3.2 million barrels a day by 1985. The analysis conducted by the Congressional Budget Office, however, indicates that this estimate of the savings is over-optimistic and that the proposals would save closer to 2.3 million barrels a day. About 0.6 of the 0.9-million-barrel discrepancy is due to different estimates on the coal conversion potential, while the remaining difference results from different estimates from the home insulation and solar equipment tax credits. The administration asserts that an additional savings of 1.3 million barrels a day (over and above the savings from the five main proposals) can be expected to result from various proposals such as new building standards; these have not been analyzed by CBO. On the assumption that these unanalyzed savings will be realized, however, the total oil import savings achieved by the administration's plan are estimated by CBO to be about 3.6 million barrels a day, rather than the administration's estimated 4.5 million barrels. The administration's plan leaves open the possibility of future measures not included in the present proposed legislation that could help close this gap.

CRUDE OIL PRICING

The administration's plan would retain controls on prices received by domestic oil producers, but it would allow the controlled price of newly discovered oil to rise over 3 years to the 1977 world price with subsequent adjustments for domestic inflation. This price would offer substantial incentives to increase production of domestic oil, but actual increases in production are likely to be relatively small. CBO estimates that the rise in price for newly discovered oil would increase production by about 100,000 barrels a day by 1985; the administration's estimate of increased production is slightly higher.

To discourage consumption of oil, the plan would raise prices paid by domestic consumers to world levels by imposing a "crude oil equalization tax" equal to the difference between world and domestic prices. This tax would capture for the public the windfall profits associated with higher prices on already discovered oil and would return those profits to consumers in the form of rebates.

The equalization tax on crude oil would increase the price of petroleum products by an estimated 4 to 5 cents per gallon (in current dollars) by 1980; this amount is in addition to the increase of 4 to 5 cents per gallon projected under existing legislation. The tax would also lead to the elimination of the so-called "entitlements program," and would thereby reduce some of the regulatory burden on the industry. The equalization tax appears to be an effective mechanism for equalizing foreign and domestic oil prices and capturing windfall profits. It would provide a slight incentive for consumers to reduce consumption or convert to alternative sources. Proposed user taxes on oil provide additional incentives for industry and utilities to convert to coal.

NATURAL GAS PRICING

The pricing proposal for natural gas eliminates the current distinction between interstate and intrastate markets by placing all gas under Federal jurisdiction; it places a cap on the price of new

gas at \$1.75 per 1,000 cubic feet. In addition, a special excise tax is placed on use of natural gas by industries and public utilities. The purpose of these proposals is three-fold:

To protect residential consumers against high prices and shortages; to make gas expensive for industries that can convert to coal; and to increase new supplies but reduce the possibilities of producers gaining excessive profits on previously discovered gas.

With the exception of the extent of coal conversion by industry, CBO finds that the natural gas proposals are likely to attain the stated objectives. The proposals would generally reallocate the existing supplies of natural gas; no energy savings would therefore be attributable to this proposal according to either the administration or our analyses.

COAL CONVERSION

Since the goal for conversion of utilities from oil and gas to coal is generally consistent with current trends, CBO concurs with the administration's conversion estimates in this area. A major discrepancy exists, however, in estimates of the likelihood of attaining the goal for industrial conversion. If present policy were continued to 1985, only 12 percent of new industrial demand would burn coal. The President's plan envisions that industrial consumption of coal would more than double by 1985. Accomplishing the administration's goal would require that 10 percent of all existing oil and gas used for industry be converted to coal and that 44 percent of all new potential users would convert to coal. The CBO analysis agrees with the President's 10-percent conversion of existing industrial use but projects only 33 percent of new uses to be converted to coal. The reasons for this lower estimate include the logistics of transporting coal, concerns about protecting the environment, and problems of scheduling new coal facilities to maximize the benefits of rebates, all of which will impede new conversion. This would result in total coal consumption by industry of 360 million tons by 1985—50 million tons below the administration's estimate.

In terms of equivalents in barrels of crude oil, CBO's estimate translates into a savings in imported oil of 1.8 million barrels a day, which is 0.67 million below the administration's figure. To some extent, however, the attainment of the goal would depend upon the future actions of the administration, since it could control both the specification of coal regulations and their subsequent enforcement.

AUTOMOBILE-RELATED PROPOSALS

The automobile-related provisions of the President's energy package are aimed at reducing gasoline consumption through production and sales of vehicles with greater fuel efficiencies, and through price-induced reductions in the number of miles driven. The goal of the plan is to reduce total gasoline consumption by 10 percent from current levels by 1985. This is an ambitious goal, considering that motor gasoline consumption has increased 4.5 percent per year between 1965 and 1975, but its attainment would be aided substantially by existing legislation. In particular, the Energy Policy and Conservation Act of 1975 set fuel economy standards for new cars under the threat of civil penalties. While CBO does not expect these standards to be met in every year, it does anticipate that they would have significant effects on automobile gasoline use. In 1985,

these standards would hold consumption within 1 percent of the present level. CBO estimates that adoption of the President's plan would reduce automotive gasoline consumption further, but to 5 percent beneath its present level, not 10 percent below, which is the goal of the administration.

Three programs in the President's plan contribute to gasoline savings. More than half of the savings come from the President's proposed "gas-guzzler" taxes and rebates based upon a new car fuel economy. This program is estimated to yield fuel savings of 215,000 barrels a day in 1985. Second, the standby gasoline tax could be triggered as early as 1982 according to CBO projections, and assuming that it is triggered then, it would produce gasoline savings of 65,000 barrels per day in 1985. Finally, the crude oil equalization tax is expected to contribute an additional 25,000 barrels a day of gasoline savings in 1985. Taken together, these three programs would yield total gasoline savings of 305,000 barrels a day in 1985, less than a tenth of the energy savings produced by the President's plan as a whole.

CBO's estimate of the fuel savings for the gas-guzzler excise tax and rebate program is slightly higher than the administration's, and the administration has not yet computed comparable estimates for the standby gasoline tax and crude oil equalization tax. The administration has indicated, however, that without the standby gasoline tax, 1985 gasoline consumption would be 350,000 barrels per day above target. While CBO expects that 1985 gas consumption would most likely exceed the target by more than this, the excess above target in both sets of projections is greater than the estimated 65,000-barrel savings of the standby gasoline tax, implying that the President's goal of a 10 percent gasoline reduction by 1985 appears unlikely.

Future gasoline consumption by trucks introduces considerable uncertainty as to whether or when the President's goal would be met. At present, trucks account for more than 20 percent of the Nation's gasoline consumption, and their future share of gasoline use could rise if their fuel economy improvement does not keep pace with that of autos. The fuel economy of light trucks is expected to improve as a result of existing legislation as well as through the President's gas-guzzler proposal as it would apply to light trucks. But both existing and proposed legislation in this area are keyed to a set of standards that have not yet been specified, so that assessment of their conservation impact is impossible at this stage. CBO analysis indicates that these future developments in the fuel economy of trucks would have a major effect on the triggering of the standby gasoline tax and could delay it from 1982, as projected above, to 1983 or 1984. Policies related to trucks play a key role in shaping an effective and even-handed policy for transportation fuel conservation.

INSULATION TAX CREDIT

The proposed insulation tax credit is likely to encourage some additional homeowners to upgrade the insulation in their homes. With sharp rises in fuel prices since 1973, however, many homeowners have already reinsulated or have decided to do so in the future. For example, about 3 million homeowners chose to

upgrade their insulation in 1976. With current energy prices, insulation is already a good investment since the savings in fuel bills average about three times the cost of the insulation. The proposed credit would increase this ratio of savings to cost to four to one.

Between now and 1985, an estimated 24 million homeowners and renters are likely to reinsulate their dwellings. CBO estimates that nearly 8 million of the 24 million would be attributable to the tax credit. The 24 million translates into a total of 70 percent of all residential homeowners as opposed to the 90 percent projected by the President. CBO estimates the energy savings attributable to these nearly 8 million households would be approximately 120,000 barrels of oil a day.

The administration, on the other hand, estimates that a savings of 480,000 barrels would be due to the credit and related programs. The major difference is that CBO estimates that an additional 280,000 barrels a day will be saved by reinsulation that people would do anyway without the Carter plan, adding up to a total of 400,000 barrels per day from all insulation. The administration assumes that a total of 480,000 barrels a day savings would be induced by the plan.

SHORT-RUN IMPACTS ON THE ECONOMY

President Carter's package would have a major impact on energy markets, a noticeable but small impact on the overall rate of inflation, and only a minor impact on total output and employment. CBO estimates that the President's plan would add about 1.6 percent of the level of consumer prices by 1980 or about half a percentage point a year to the rate of inflation from 1978 through 1980. The output effect is estimated to reduce constant dollar Gross National Product by no more than 0.7 percent by the end of 1980, thus adding 0.2 percent to the unemployment rate. These estimates do, however, assume that there will be no new investment for conversion during the next 2 years. The total impacts on unemployment and real growth could therefore be partially offset if additional investment is forthcoming.

DISTRIBUTION EFFECTS

A final issue I would like to address is the combined impact that the energy proposals and tax rebates would have on consumers. Assuming that the crude equalization and natural gas and oil excise taxes are passed on almost entirely to consumers, approximately \$15 billion will be paid in 1980 (in 1977 price levels) in terms of higher energy prices, and this will increase to about \$25 billion in 1985. While the rebate provisions of the President's plan would refund almost all of these additional energy payments back to the American people, the energy proposals will generally redistribute purchasing power from persons at upper income levels to persons at lower levels of income. Other transfers are likely to take place. For example, nonautomobile owners stand to gain at the expense of automobile owners. Homeowners would gain at the expense of renters, and persons living in cities with access to public transportation would gain at the expense of persons in suburbs and rural areas.

Thank you, Mr. Chairman.

Mr. DINGELL. Doctor, yours is a most impressive statement for which the committee thanks you.

At this time the Chair recognizes my colleague from Michigan, Mr. Stockman.

Mr. STOCKMAN. Dr. Rivlin, I highly regard your economic expertise and the work that you do at the CBO. Therefore, I would like you to comment as an economist on a couple of things that I find in the overall plan that really do not seem very consistent or that do not seem to have a very solid economic rationale.

The one that pops out first is the reference price for new natural gas and new petroleum or oil. The reference price for natural gas is tied to the refiner's acquisition cost for domestic crude, which includes the various tiers and so, therefore, is going to be about \$10 a barrel now, but the reference price for new oil after a 3-year phase-in is going to be the world price adjusted for inflation, and so what you have is a premium fuel, natural gas referenced to a lower price than new oil, although the definitions for both are the same, 2-1/2 miles from existing wells, 1,000 feet below a current producing zone.

Since natural gas is a relatively more valuable commodity or fuel because it costs less to burn and you don't have all of the associated costs, what real sense does it make to have this differentiation in the reference price, particularly with the downward bias in the case of natural gas? On any reasonable economic basis you would probably do it the other way if you were going to do that.

Dr. RIVLIN. I think the basic rationale is: There is a world price of oil that can be fairly easily determined, and this price is the real cost to the American economy of importing oil. Natural gas is a little different. The supply factors are a little different, and if the price were allowed to rise to something close to its natural price, whatever that is—

Mr. STOCKMAN. I am not necessarily saying its natural price, but it is tied to the controlled domestic acquisition cost, which is much lower than the incremental supply, alternative supply. If you can't get natural gas, you might use fuel oil and that is going to be tied to the world price, but I don't really see the rationale for using two different reference prices for the new oil and for the new gas when in terms of the field level activity, they are defined exactly the same.

Dr. RIVLIN. Let me ask some of my colleagues to comment on that.

Ray, would you like to, or Dr. Morgenstern?

Dr. MORGENSTERN. I agree with Dr. Rivlin's statement that essentially there is a well-defined market in the case of oil. In the case of gas, of course, it is a different situation. I think there is some fear that were gas prices to have either no cap or a much higher cap, there would be very little pressure to keep them down, that is, to keep them away from what might be \$4 or \$5 per thousand cubic feet. This is because of the long-term contracts for gas and the nature of rolling in prices. I think that would be the justification.

Mr. STOCKMAN. What I am saying is if you tied the cap that they are proposing to the world price for oil, like you are doing with new oil, instead of \$1.79 it would probably be in the range of \$2.05, \$2.10,

or \$2.15 and I can't really see the rationale for the distinction, but since apparently we don't agree, or we don't see the point, maybe we will go on to another question.

Dr. MORGENSTERN. There is one final point, namely, that, of course, the cap is permitted to rise over time.

Mr. STOCKMAN. Both of them rise with domestic inflation, so once the initial level of the cap is set on the basis of this reference price, since they would both be allowed to rise with domestic inflation, that differentiation would be maintained but this leads to the second question.

In the case of natural gas the alternative supply for those end users who do not have the flexibility, at least in the medium term, to go directly to coal combustion, the alternative supply to conventionally produced natural gas is either going to be synthetic gas at \$4 a million Btu's, or LNG at \$4 to \$5 or coal, gasified coal, that will come in at \$3 to \$6 depending on whether it is high Btu or low Btu and so forth or Canadian imports that are certainly going to be in the range of \$2 to \$3 or even more.

Now what sense does it make to charge the economy anywhere from \$3 to \$6 for these alternative or supplemental supplies when we are unwilling to allow the economy to pay more than \$1.79 for conventionally produced gas, because, it seems to me, that unless you have that flexibility, which I don't think you have, and I don't think it has been demonstrated in the hearings, to go off gas over the next 10 years and immediately to direct coal combustion what is really going to happen in the economy is that you are going to go off conventionally produced gas and to high cost methane that would be in costs way above what anyone would suspect the uncontrolled or decontrolled price of natural gas to go. I can't see the economic logic in it but maybe you can see something that I don't.

Dr. MORGENSTERN. I believe the reason that would be consistent with our view is that the supply response resulting from higher domestic prices is expected to be rather small.

Mr. STOCKMAN. But for every increment you produced if you got it at \$2.50 per thousand cubic feet that is a lower total cost to the economy than the increment that would be produced at \$4 in the synthetic plant. I fail to see why it is bad to pay \$2.50 for that incremental supply produced conventionally when it is all right to pay \$4 for the alternative.

Dr. RIVLIN. I think possibly these are questions that would be well addressed to Mr. Schlesinger, if you haven't so addressed them already. There is really a different view of what is going on in gas, I think; from what is going on in oil; in oil it is appropriate to use the free market, and in gas there is an objective of protecting the residential user and of using regulation and nonprice methods over time to phase out other uses. This may explain part of what seems to be superficial noneconomics.

Mr. STOCKMAN. You were talking about the equity impacts, and there may be some transfers from rural residents to urban and from auto drivers to nonauto drivers and so forth, but what about the household sector, where you have maybe 40 million are on natural gas and we are going to preserve for them a cheap supply for the next 10 or 15 years because of the incremental pricing

provisions and because of the reallocation of gas to the household sector from industry. But then you have another 20- or 30 million who are either on electric heat or who are on fuel oil which is going to cost two to five times more.

Mr. DINGELL. The time of the gentleman has expired.

Mr. STOCKMAN. It seems to me there are serious equity problems there.

Mr. DINGELL. You may respond to the question, Doctor.

Dr. RIVLIN. Well, there may be some equity problems here. I am not quite sure that we guarantee equity among all household uses, depending on what one started with in heating a house. The cost for a household of changing over is very considerable.

Ray?

Dr. SCHEPPACH. Households are protected too because taxes on home fuel heating are rebated directly to the distributor and thus do not show up as higher price there. Even on electricity, I think they are attempting to switch the rate regulations so that large consumers do not benefit at the expense of small consumers of electricity. In sum, I think there are several things in the plan which attempt to isolate the household from the price increases.

Mr. DINGELL. The time of the gentleman has expired.

Doctor, you said at page 3 of your statement "This potential gap between the energy savings of the plan and the act depend significantly on a number of additional regulatory decisions" and then you cited exceptions for mandatory coal conversion over which the administration would have control.

Would you amplify on that, not at this time, but for the record, if you please?

Dr. RIVLIN. Certainly, Mr. Chairman. [See pp. 39-51 of CBO report.]

Mr. DINGELL. You stated, I think, in your very excellent study at the bottom of page 4, that "The Administration estimates that altogether, these proposals would achieve a reduction in oil imports of approximately 3.2 million barrels a day by 1985."

Then you indicated that the savings you felt were over optimistic, and that the savings would be closer to 2.3 million barrels a day.

Could you, first of all, tell us why, and, second of all, indicate to us what you meant when you said below, that 0.6 of the 0.9 million barrel discrepancy is due to different estimates of the coal conversion potential while the remaining discrepancy results from different estimates of home insulation and equipment tax credits?

Can you tell us what those assumptions are, please? First, why the difference in your estimates, and, second, what are the differences in your assumptions? If you wish, you may submit those for the record.

Dr. RIVLIN. We could do it either way, but we would be happy to submit those for the record. The reasoning is amplified in the report itself.

Mr. DINGELL. You might just indicate the reasoning to us at this time, because I think it would be helpful to us to have that, and then you can amplify on it if you please.

Dr. RIVLIN. The major differences, as we said, are with respect to industrial uses of coal and the effect of the home insulation credit.

With respect to industrial use of coal, which accounts for a major part of the savings that the administration claims the plan would generate, the administration is assuming that 44 percent of new industrial uses of fuel would be coal. Under present policy it would only be about 12 percent.

We think that getting to 44 percent is extremely optimistic and that only about a third would actually be new uses of coal.

Mr. DINGELL. Can you advise me why you make the assumption that the coal conversion estimates of the administration are optimistic?

Dr. RIVLIN. A variety of factors, Mr. Chairman.

Mr. DINGELL. Environmental?

Dr. RIVLIN. One of them would be environmental. Another would be the problems of transporting coal to factories. Another would be the nature of the tax and rebate system itself, which does provide an incentive for those who are converting to stretch out their conversion over a period of time; this means that the full effects probably wouldn't be seen until after 1985. Indeed if one looks beyond 1985 to, say, 1990, then we think that the administration's estimates are more realistic.

Mr. DINGELL. Doctor, in other words, you are saying they move their effective period forward.

Dr. RIVLIN. Yes. It is closer than we feel is realistic.

Mr. DINGELL. You indicated that you had not, at the top of page 5, analyzed the savings which could result from the various proposals such as new building standards. I recognize we are asking you to do a great deal for us. Can you give us whatever tentative analysis you can give us with regard to these points, please, not at this time but if you can for the record?

Dr. RIVLIN. Yes. We will be working on some of the other proposals in the plan to the extent that we are able to. The plan has a large number of different proposals—about 100 of them—and we will endeavor to look at as many of them as we can before the Congress is forced to make its decision. [See pp. XIII-XXI of CBO report.]

Mr. DINGELL. You indicated that you thought the total oil import savings to be achieved by the administration's plan are estimated by CBO to be 3.6 million instead of 4.5 million.

Can you indicate to us for the record why you make that statement, and what is the breakdown of those figures? You don't need to do it now, Doctor, but just for the record.

Then you said the administration's plan leaves open the possibility of future measures which could close the gap and which are not included in the present proposed legislation.

Could you indicate to us at this time what you feel these to be, please?

Dr. RIVLIN. They would probably be regulatory devices designed to hasten coal conversion, for instance, or to improve the effectiveness of home insulation. The possibility of a transfer regulation on homes is one that has been talked about and and that I believe is alluded to in the President's proposal; namely if the tax credit on home insulation doesn't do the trick, that is, if it does not bring the reinsulation of existing housing stock up to 90 percent, another

possibility would be a regulation that no one could sell his house unless it had been reinsulated. That is an example of the kinds of things that are possible.

Mr. DINGELL. You have indicated a little later on the page that CBO estimates that the price rise for newly discovered oil would increase production by 100,000 barrels a day by 1985. "The administration estimate of increased production is slightly higher." Could you tell us, do you find any significant differences between the two elements?

Dr. RIVLIN. No, I don't think they are very important. Nobody thinks that it is going to be a huge increase.

Mr. DINGELL. On page 9, you said that the gas guzzler tax would save 215,000 barrels of petroleum per day in 1985. How would this figure change, if you assume that the current standards in EPCA would be met?

Dr. RIVLIN. Let me see if Dr. Morgenstern can answer that one.

Dr. MORGENSTERN. I think I will defer to Dr. Kulash.

Dr. KULASH. We didn't analyze that case in particular, but I think we could predict that the savings would be less than 215,000 barrels per day. The cost of making fuel economy improvements tends to increase as more and more of these improvements are incorporated into vehicles. Thus, if the current standards were met or some other incentives were established to insure their being met by 1985, continuing to achieve further improvements through economic incentives applied to manufacturers would get harder. So our estimate would come down from 215 to some lower number; we haven't worked out what the lower number would be.

Mr. DINGELL. Could you tell us what that lower number is, please, sir?

Dr. KULASH. We haven't analyzed that case.

Mr. DINGELL. Isn't your statement on this point based on the fact that you don't believe EPCA standards could be met?

Dr. RIVLIN. Yes, that is right. We are assuming they will not be fully met by 1985 without additional measures.

Mr. DINGELL. Can you tell me why not? How do you come to this assumption?

Dr. RIVLIN. Well, just analyzing what is happening, it seemed unlikely that they would be met, but perhaps Dr. Kulash would like to amplify that.

Dr. KULASH. There are two major reasons why we don't think they will be met. The first one is that our projection of the cost of improving fuel economy to the degree called for in the standards is so prohibitive that it would simply be more economical for the manufacturers to pay the penalties than to try to improve vehicles up to that point.

Mr. DINGELL. You are aware of what the level of the penalty is, aren't you?

Dr. RIVLIN. Yes.

Mr. DINGELL. \$50 a car, isn't it?

Dr. RIVLIN. Before taxes, and it is, of course, even greater if you look at it in terms of the after tax effect.

Mr. DINGELL. \$50 per mile per car?

Dr. RIVLIN. Yes.

The second reason, which is closely tied to that, is that we do not foresee a major shift in purchasing patterns by consumers toward smaller vehicles either as a function of the current law or as a function of the provisions in the Carter package. As a result, the saving has to come almost entirely out of technological improvements. There is very little change in market composition, in terms of the types of vehicles sold, that aids the manufacturers in meeting that goal. I think our projections differ from some others in that respect.

Mr. DINGELL. I find myself hard put to see how an automobile firm would be delighted to pay \$50 additional on its automobile. Maybe you can explain that to me. That is a subtlety of economics and finance that escapes me, I must tell you.

Dr. KULASH. Under the provisions of the Carter package, we project that there will be somewhere between \$400 and \$600 of additional machining that goes into each vehicle in order to produce more fuel efficient vehicles than would be produced otherwise. The \$50—or looked at after taxes, approximately \$100—effect per mile per gallon is of the same order of magnitude, and there are tradeoffs that the manufacturers face between adding more fuel economy, which costs more than \$100 per mpg to produce, or simply paying the penalties, which you know peak out at \$100.

Mr. DINGELL. As I understand it, the tax is on the manufacturer, is it not?

Dr. KULASH. Under the Carter—

Mr. DINGELL. Under the Carter proposal, yes.

Dr. KULASH. It is paid by the manufacturer.

Mr. DINGELL. Paid by the manufacturer. The manufacturer also gets a rebate, does he not?

Dr. KULASH. Yes.

Mr. DINGELL. How does this impel him to assess it, given the freedom he has to price his automobiles against any particular class of consumers who might purchase a particular category of automobile?

Dr. KULASH. As far as I know, there is no provision in the law that compels him to change his prices in such a way as to avoid having these payments.

Mr. DINGELL. Let's just take a well known manufacturer, General Motors, which manufactures both Cadillacs and Vegas. They are taxed on the Cadillacs. Let's assume that the Cadillac doesn't meet the test. They get rebates on the Vegas. Let's assume that the Vega does meet the test. What is the assurance that, given the pricing freedom that the manufacturer has under that bill, that he would necessarily assess the tax against the Cadillac and give the rebate to the Vega and not do the other way around, if he has got a whole lot of Vegas sitting on his lots?

Dr. KULASH. There is no legal assurance in the bill. The only incentive in that direction is the economic one: That manufacturers who produce fewer of the Cadillac-type vehicles would not have the penalties, which they have to write off, and that the rebates would be passed through on all or a greater percent of their products. Thus a firm like GM would have to compete with a manufacturer that produced a greater proportion of fuel efficient cars.

Mr. DINGELL. Would I be fair in assuming that this is not an assumption that you would regard as being cast in rock or constructed of armor plate?

Dr. KULASH. Which assumption, Mr. Chairman?

Mr. DINGELL. The one that we are now discussing, that you are making, with regard to the tax and rebate as to how the manufacturer would follow it?

Dr. KULASH. I believe that there is a considerable uncertainty as to exactly how they would pass this through.

Mr. DINGELL. Thank you.

The time of the Chair has expired.

The Chair recognizes the gentleman from Indiana, Mr. Sharp.

Mr. SHARP. Thank you, Mr. Chairman.

I will be brief. I unfortunately missed the first part of the presentation here, and I just wondered if CBO has done any work on other options on natural gas, either deregulation, some version on new natural gas, or other caps.

Do you have a different analysis of the impact on that for producers or for production or for the cost to consumers?

Dr. RIVLIN. We have not looked explicitly at other proposals, though we have some idea of the direction in which they would take us.

Mr. SHARP. But you wouldn't have judgments independent of those we get from FEA, FPC, and the administration?

Dr. RIVLIN. No. If there were a specific set of alternatives that you would want us to examine, we might be able to give you some judgment.

Mr. SHARP. I did have a question though I can't think of it at the moment, Mr. Chairman, on the automobile thing.

I yield back my time.

Mr. DINGELL. Does the gentleman from Michigan have further questions?

Mr. STOCKMAN. I want to follow up on the question that the chairman opened up on the fuel economy standards. I direct this to the CBO's fuel economy plan. We have discussed the rule of essential equivalency, that is, as we try to close the gap between supply and demand in the 1980's it is whether we do it on production side or conservation side or whether we try to conserve in one sector of the economy or another will depend on the cost of doing it, the real cost to the economy of doing it. What that means is that if it is going to cost \$30 or \$35 per barrel to save one more mile per gallon as you get up the ladder, maybe that isn't a very sensible thing to do.

What I am asking, I guess, is has anyone really done any detailed analysis on the marginal costs for increasing fuel economy on cars? Common sense would tell you when you go from 18 to 19 miles a gallon it is probably pretty cheap to do that in terms of additional capital costs on the car. When you go from 25 to 26 it is going to become more expensive, but how about when you get up into the upper 20s and the 30-mile range, in terms of constant carrying capacity and load space and that sort of thing? Do you have any information on that or is work being done that might be useful to the Congress as we look at the various places that we can get conservation and at what cost?

Dr. KULASH. There has been a lot of work done on which specific technological changes to cars could be made and estimates of what various devices or alterations, made on a change-by-change basis would bring about in terms of improved fuel economy.

Our own projections are based on one synthesis of this kind of literature, which was done for us—actually for the Federal Energy Administration—by an engineering firm that attempted to go through and look at four different vehicle-size classes at different points in the future. The examination was made under various assumptions about environmental regulations and safety regulations. It tried to narrow down some of the very disparate estimates in the literature.

I know of this one study, but I really do not know of any more recent ones that have attempted to synthesize all the various possibilities and try to see how much additional fuel economy an additional \$50 or \$100 would buy.

Dr. RIVLIN. That synthesis does confirm the Congressman's common sense. However, it gets more expensive as you go along.

Mr. STOCKMAN. The reason I asked that, as you indicated, you felt unless we go to some very coercive tactics or strategies in terms of telling consumers what they have to buy, the structure of market demand is not likely to change very much, and therefore you indicated that any fuel economy gains are going to have to come from technological improvements and basically capital substitution.

If that is the case, it seems to me that we need to have some information as to what the cost of that capital substitution or technological improvement is going to be and, if it is prohibitive, then you might have to think about more coercive strategies in terms of vehicle miles that can be driven and the kinds of cars that people can buy, which I do not think this Congress is in any mood to consider at the moment.

We ought to know that that is one of the more drastic actions that we might be facing, if this first-round plan is not as successful or as effective as expected and, as you have indicated today, in your own opinion it probably will not be.

Dr. KULASH. One estimate that we have not made—but could furnish for the record—would be to look at the total of an additional investment in the auto manufacturing industry, which would be stimulated by this provision in the Carter package. It would be possible to compare the results to the net fuel savings produced by that same provision.

Mr. STOCKMAN. Have you done any work on net fuel savings by moving away from the engine in the automobile and looking at vehicle miles?

I did one rough calculation which indicated if you had a 1 percent vehicle-mile growth rate in the 1980's as opposed to a 3 percent growth rate, which is about the historical average, the net difference in annual consumption by 1990 would be 880,000 barrels, which is far more than we are talking about with any of the measures that are included in the plan.

The only thing I do not know is how you get from 3 percent to 1 percent in terms of what it requires of people.

Dr. KULASH. Under our projections, continuing growth in the vehicle miles of travel shows up, and also a substantial increase in the vehicle miles of travel per household. The latter is partly due to the fact that, even under the provisions of the Carter plan together with the fuel economy expected under existing legislation, we anticipate that the cost per mile of fueling a car will fall in the future. It would fall fairly substantially under the EPCA provisions and somewhat less under the Carter plan, but in either case, we expect the average miles traveled per household to rise from about 15,000 miles per year as it now is to about 17,000 miles per year under the Carter plan in 1985. This figure is in contrast to about 18,000 miles per year projected under the EPCA alone.

Mr. DINGELL. The time of the gentleman has expired.

The Chair recognizes the gentleman from Indiana, Mr. Sharp.

The Chair recognizes the gentleman from Pennsylvania, Mr. Walgren.

Mr. WALGREN. No questions, Mr. Chairman.

Mr. DINGELL. Doctor, in your statement you said:

A major discrepancy exists, however, in estimates of the likelihood of attaining the goal for industrial conversion. If present policy were continued to 1985, only 12 percent of new industrial demand would burn coal. The President's plan envisions that industrial consumption of coal would more than double by 1985.

Could you indicate, not now but for the record, why you make that statement, please?

Dr. RIVLIN. Yes, Mr. Chairman. [See pp. 39-51 of CBO report.]

Mr. DINGELL. A little later on page 7 you said the following:

The CBO analysis agrees with the President's 10 percent conversion of existing industrial use but projects only 33 percent of new use to be converted for coal.

Then you go on to say:

The reasons for this lower estimate include the logistics of transporting coal, concerns about protecting the environment, and problems of scheduling new coal facilities to maximize the benefits of rebates, all of which impede new conversion.

These are points that are of much concern to the committee and if you could give us a rather clear and concise statement as to each of these, it would be much appreciated, and also describing the reasons for the lower estimate. You can do that for the record.

Dr. RIVLIN. We will certainly try to do that, Mr. Chairman. [See pp. 39-51 of CBO report.]

Mr. DINGELL. You said on page 8, I thought it was an excellent point:

To some extent, however, the attainment of the goal would depend upon the future actions of the administration since it could control both the specification of coal regulations and their subsequent enforcement.

Would you amplify on that for the record, please?

Dr. RIVLIN. Yes. [See pp. 39-51 of CBO report.]

Mr. DINGELL. Then you went on, and we discussed this, but you said:

While CBO does not expect these standards to be met in every year, it does anticipate that they would have significant effects on automobile gasoline use,

referring to the automobile efficiency, and at page 9 at the top you went on to say:

CBO estimates that adoption of the President's plan would reduce automotive gasoline consumption further, but to 5 percent beneath its present level, not 10 percent below, which is the goal of the administration.

For the record, when you find time, would you give us the explanation on that particular point if you please. [See pp. 61-67 of CBO report.]

Mr. DINGELL. You said a little further down at page 9:

Standby gasoline tax could be triggered as early as 1982 according to CBO projections, and assuming that it is triggered then, it would produce gasoline savings of 65,000 barrels per day in 1985.

Could you submit for the record why you feel that the gasoline tax could be triggered at that point, and give us also, if you please, a statement as to why you assumed it would produce gasoline savings in the order of 65,000 barrels a day? That again, Doctor, for the record. [See pp. 61-67 of CBO report.]

Mr. DINGELL. Continuing at the top of page 10, you discussed 1985 gas consumption, which would likely exceed the 350,000 barrels per day target by more than this.

Could you submit the date for the assumptions that went into that paragraph and the paragraph at the bottom of the prior page? [See pp. 61-67 of CBO report.]

Mr. DINGELL. At the middle of page 10 you state:

The fuel economy of light trucks is expected to improve as a result of existing legislation as well as through the President's gas-guzzler proposal as it would apply to light trucks.

This brings to mind two questions.

One, you have indicated a lack of adequate faith in the requirements of EPCA, and the question I would like to ask is, do you have some suggestions for us as to how we can tighten those standards to assure that the goals of EPCA are met in an appropriate fashion?

Could you do that for us, please, Doctor?

Mr. SHARP. Will you yield?

Mr. DINGELL. Yes, I will be glad to yield to my friend.

Mr. SHARP. I wonder if the gentleman dealing with the automobile section would be able to provide us perhaps even now an indication of what civil penalties would be necessary to begin to make it economically—so they would not engage in a trade-off of accepting the penalty rather than making the improvement. There is the possibility that that is where the adjustment needs to be made, or there are other possibilities.

Dr. RIVLIN. That is an amplification of the chairman's basic question.

Mr. DINGELL. That is a concern of mine. I am not lightly disposed to pass laws that are going to be ignored by anybody. That is not our function up here.

You discussed the question of trucks, both with regard to light duty trucks, and also with regard to heavy trucks. Could you give us some suggestions about how this could be tightened up?

Your statement indicates to us that the question of gasoline and diesel consumption by trucks may be a substantial problem, and may not be addressed in either EPCA or in the administration bill which we are considering.

If you could give us that statement it would be helpful.

Dr. RIVLIN. For light trucks, Mr. Chairman, we do not yet have any standards. It would be a question of tightening up somewhat.

Mr. DINGELL. You are suggesting then we ought to get hold of the Department of Transportation and inquire why they rest so lightly by their duties.

Dr. RIVLIN. I think that is a possibility.

Mr. DINGELL. That will be done.

You referred at page 11 here, you said:

Between now and 1985, an estimated 24 million homeowners and renters are likely to reinsulate their dwellings.

Then you went on and made a number of estimates. Would you submit to us the data for the assumptions that went into that? I think those would be most helpful to the committee. [See pp. 84-89 of CBO report.]

Mr. DINGELL. You discussed distribution effects on page 12. The last paragraph, I thought, was extremely useful. Can you describe for us the level of taxes and rebates on a year-by-year basis with regard to this matter?

We have had a great controversy as to how much would be extracted in taxes under the administration's, different tax proposals and how much would be rebated to the consumers. I think it would be very helpful if you told us your beliefs on this matter as best you might at this particular time, with possibly a later amplification for the record.

Dr. RIVLIN. On a year-by-year basis, yes, I think we can do that, or maybe Dr. Morgenstern would like to talk to that right now. We can amplify later.

Dr. MORGENSTERN. Yes, Mr. Chairman. I am referring to page 130 of our report just published.

What we have done here for the 2 years 1980 and 1985 is, we have broken out the net gain or loss stated in real terms for various quintiles of the income distribution. What we find is that for 1980, the bottom two quintiles are net gainers as a result of the higher prices and of the rebates. The middle quintile breaks even, and the top two quintiles respectively lose .1 percent and .4 percent of real income.

For 1985 the situation is similar. For that year the losses begin at a slightly lower level than the income distribution, and we find that the bottom two quintiles gain and the upper three quintiles lose, moving up to a maximum of 0.6 percent of income for the upper quintile.

Mr. DINGELL. Could you give us that figure?

We have heard figures as high as \$100 billion coming out of the economy, and \$50 going back. I just recall hearing that. Can you give us an idea of what the levels of income flows in and out will be from the tax and rebate proposal?

Dr. RIVLIN. Mr. Chairman, are you really talking about the total effect on the budget?

Mr. DINGELL. Yes.

Dr. RIVLIN. How much comes in and how much goes out?

Mr. DINGELL. Yes.

Dr. RIVLIN. I am not sure that we have done an independent estimate of that.

Mr. DINGELL. I think the best way, Doctor, you could help us would be if you take a look at those figures and perhaps give us your judgment as to whether they are valid and what they in fact do mean.

Dr. RIVLIN. We will do that.

Mr. DINGELL. If you do that for the record, I think that will be very helpful. [See pp. 97-100 of CBO report.]

Mr. DINGELL. The Chair recognizes Mr. Potter for questions.

Mr. POTTER. With respect to your coal conversion estimates, Dr. Rivlin, I am wondering how sensitive are your conclusions of the trajectory of potential conversions to the state of the economy.

The administration assumes that with a 2 percent energy growth you will find in the neighborhood of a 4 to 5 percent of growth in GNP. If that assumption is incorrect—if for some reason the GNP rate of growth is not so high—it seems to me that this might substantially inhibit the rate at which we convert existing plant to coal.

Does your analysis encompass this kind of concern, and how do you react to it?

Dr. RIVLIN. I would think your assumption or your speculation is approximately right, although of course, if the economy does not grow as rapidly, we will use less energy overall. But let me see if someone would like to comment on that. I do not think we have looked at the sensitivity question to alternative growth paths.

Mr. POTTER. That is all the questions I have.

Mr. DINGELL. The Chair recognizes Mr. Schroeder.

Mr. SCHROEDER. Thank you, Mr. Chairman.

I wonder if we could talk briefly about the concept of market clearing prices, particularly for natural gas. Market clearing, as I understand it, is basically the situation in which the price reaches a level where long run demand and supply are brought into balance. Is that right?

Dr. RIVLIN. Yes.

Mr. SCHROEDER. The argument seems to be pretty much pervasive these days that the market clearing price for new natural gas will be somewhere in the order of \$2.50 per Mcf. I think the basis for that is the argument that people will switch to oil or to other substitutes if the price gets much above that, the \$2.50 being the Btu equivalent price of imported oil.

Right now we are presently consuming roughly 20 Tcf a year of natural gas. Presumably demand is at least that high, if not higher. Additions to reserves of natural gas are running somewhere in the range of 10 Tcf a year, so that in effect, but for what is sitting in the pool of proven reserves, our supply is about 10 Tcf a year and our demand is twice that.

My concern arises from the fact that gas sales, under long-term contracts, will "mash" the effect of high priced new gas on marginal demand. Therefore, on the supply side, would not someone who tries to make the case that a market clearing price for natural gas is \$2.50 have to make the case that we would double our supply of natural gas, that is double the rate of reserve additions, if the price rose to \$2.50, or roughly 25-percent over the current intrastate price of roughly \$2.

Simply stated, to obtain a market clearing price of \$2.50, you have to elicit, would you not, twice as much reserve addition as you presently do, at a price increase of roughly 50 cents, or 25 percent above the current margin price?

Is that a proper statement of the economic issue?

Dr. RIVLIN. It is awfully hard to talk about market price with natural gas, because the arrangements are such that it all gets mixed up together. But let me ask Dr. Morgenstern to comment on that.

Dr. MORGENSTERN. Mr. Schroeder, you have very eloquently described the process by which increases in price may or may not bring forth additional supplies. I believe you are perfectly correct, that the implied, as we say, elasticity of supply is far greater than most experts feel would be the case.

Mr. SCHROEDER. In the scenario that I have just laid out, the supply elasticity would be 4, that is a 100 percent increase in supply at a 25 percent increase in price. What is the range of conventional estimates of the supply elasticity for natural gas? Is it anywhere near 4?

Dr. MORGENSTERN. Mr. Schroeder, the scientific literature is very diverse in this field, as you are aware, but I have never seen a supply elasticity as high as 4. I believe that most studies with which I am familiar conclude that the elasticity is below 1.

Mr. SCHROEDER. So would that not therefore suggest that at least in the near term, the market clearing price for natural gas would be much higher than \$2.50?

Dr. MORGENSTERN. I believe that is correct.

Mr. SCHROEDER. Thank you.

I wanted to elaborate briefly on one of the aspects of the coal conversion program that the Chairman asked for clarification on earlier. I think this will be part of your response, but I wonder if we could probe it briefly now. The administration staff, through a fairly complicated model, came up with an estimated volume of coal conversion based on the incentives created by the oil and gas consumption taxes, creating a certain magnitude of economically justified conversion to coal.

They then said that environmental restrictions would reduce this economically justified volume of conversion by 25 percent. 25 percent of the total would not occur. I wonder if one of the reasons why your conclusions about coal conversion are less optimistic, is that perhaps you assume that greater than 25 percent of economically justified conversions would be barred by environmental restrictions.

Is that a source of any difference between the two studies?

Mr. MORGENSTERN. Yes, I believe that is true. There are other factors as well. There are problems of transportation and problems of optimizing the time one chooses to install the equipment because of the mechanics of the tax.

Mr. SCHROEDER. Thank you, Mr. Chairman.

Mr. DINGELL. Doctor, we thank you for your help. You and your associates have given us most valuable testimony. I want to say that I realize that I have laid a great deal upon you, but your assumptions here will be most valuable to us.

Thank you all very much.
[Testimony resumes on p. 289.]
[The CBO report referred to follows:]

PRESIDENT CARTER'S ENERGY PROPOSALS: A PERSPECTIVE

Staff Working Paper

June 1977 (Second Edition)

CONGRESSIONAL BUDGET OFFICE
U.S. CONGRESS
WASHINGTON, D.C.

PREFACE

One of the major issues to be decided by the 95th Congress is that of a national energy plan. Decisions on energy policy will affect virtually every household and business in the United States, with direct impacts on patterns of consumption and investment practices, and indirect effects on unemployment and economic growth. The complex proposed system of energy-related taxes and rebates may also be felt--often unevenly--by different income groups, regions, and economic sectors.

At the request of the Senate Energy and Natural Resources Committee and the Ad Hoc Committee on Energy of the House of Representatives, the Congressional Budget Office has prepared this preliminary evaluation of the Administration's proposed National Energy Plan. While it is impossible at this stage to provide a comprehensive analysis, the information presented here may assist in focusing the Congressional debate. In keeping with CBO's mandate to provide objective analysis; this report contains no recommendations. More detailed analysis of specific proposals will be prepared over the next several months.

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SUMMARY

The energy plan submitted by President Carter to the Congress contains more than 100 interdependent proposals aimed at reducing consumption of petroleum, converting from oil and natural gas to coal as an energy source, and increasing domestic supplies of energy. These proposals are designed to reduce imports of crude oil from a potential 11.5 million barrels a day to 7.0 million barrels by 1985. Of these projected 4.5 million barrels a day saved, the Administration estimates that approximately 2.1 million would be attributable to conservation and 2.4 to the substitution of coal for oil and gas.

This report analyses five major sets of proposals in the Administration's plan:

- o Pricing of crude oil,
- o Pricing of natural gas,
- o Conversion to coal,
- o Automobile-related proposals, and
- o Tax credits for home insulation and solar heating equipment.

The Administration estimates that altogether, these sets of proposals would achieve a reduction in oil imports of 3.2 million barrels a day by 1985. The analysis conducted by the Congressional Budget Office and presented in this report, however, indicates that this saving is overoptimistic; CBO estimates that the proposals would be likely to save closer to 2.3 million barrels a day. About 0.6 of the 0.9-million-barrel difference results from lower estimates of coal conversion potential; the remaining 0.3-million-barrel discrepancy is due to differing estimates of the results from the home insulation and solar equipment tax credits. The Administration asserts that an additional savings of 1.3 million barrels a day (over and above the savings from the five main proposals) can be expected to result from various proposals such as new building standards; these have not been analyzed by CBO. On the assumption that these unanalyzed savings will be realized, however, the total oil import savings achieved by the Administration's plan are estimated by CBO to be about 3.6 million barrels a day, rather than

the Administration's estimated 4.5 million barrels. The Administration's plan leaves open the possibility of future measures not included in the present proposed legislation that could help close this gap.

THE NEED FOR AN ENERGY PLAN

The need for a national energy plan arises from both immediate and long-run problems. The long-run problem is simply that the growth in oil and gas consumption exceeds the growth in proven reserves--both domestic and foreign. Before long, we will have to shift to new energy sources or face drastic reductions in our standard of living. The more immediate problem is that U.S. imports of oil have increased substantially--from 3.5 to 7.3 million barrels per day between 1970 and 1977. The fact that almost half of the oil consumed in the United States is now imported creates national security risks and makes our economy highly vulnerable to shocks from outside, especially because the supply and price of oil are to a great extent dictated by an international cartel.

The major reason for the substantial increase in our dependence on imports is the current system of price controls on oil and gas, which have kept the domestic price of these fuels artificially below world levels. Over the past four years, this regulatory system has served to cushion Americans from the dramatic shifts in consumption, and in turn in lifestyles, that might otherwise have been caused by the abrupt quadrupling of world oil prices by the OPEC cartel in 1973-1974. Artificially low prices have also tended to encourage energy consumption and discourage the search for and production of new domestic resources--thereby further increasing our dependence on potentially unreliable foreign suppliers.

THE ADMINISTRATION'S STRATEGIES

To reduce our dependence on imports, the President has proposed three major strategies:

- o Reduce the long-term growth in energy demand by imposing various excise taxes that would serve to raise the price of petroleum and related products to world levels or near world levels. New regulatory standards are also proposed, and special efforts are made to reduce the growth in demand for gasoline.

- o Increase large industries' and utilities' use of coal instead of oil or natural gas by taxing their use of the latter two fuels. Regulations are designed to prohibit most new industrial and utility use of oil and natural gas.
- o Increase domestic supplies by reintroducing market pricing, or near market pricing, for truly new energy supplies. Accelerated development of new energy sources, however, is not stressed.

A critical element in the President's proposal is the effort to raise the price of petroleum and natural gas by predictable increments so that consumers and businesses can begin to make decisions on the basis of higher future energy prices. The theme of the plan is that the transition to a less energy-intensive economy is a long and complex process. Incentives established now to alter consumption and investment decisions regarding energy will only begin to yield significant savings within the next few years. Truly large-scale energy savings will not show up until the middle of the next decade or later.

Energy price increases under the plan would be achieved mainly by a system of taxes to be rebated to consumers. Such taxes are preferred to simple increases in private-sector prices because the taxes capture windfall profits for the public rather than for industry. These tax revenues would then be rebated in order to maintain the real purchasing power of consumers. Since the taxes would have raised energy prices relative to others, however, it is expected that most of the rebates would be spent on other goods; energy would thus be saved.

CONCLUSIONS OF THE STUDY

The general conclusion of the CBO analysis is that the strategies proposed by the Administration would be effective in reducing energy use and dependence on oil imports, but that the Administration's estimates of the magnitudes of import savings are overoptimistic.

One of the costs of the plan would be a rise in the general price level, but the inflationary effect would be small and gradual compared to that of the OPEC price increases of 1973-1974. The plan would redistribute real income from some groups to others, but on the average, lower-income people would be protected. The shift to a more energy-efficient economy envisioned by the plan would not involve dramatic adjustments in American lifestyles; for example, the increase in miles driven per household would be slowed but not reversed.

Crude Oil Pricing

The Administration's plan would retain controls on prices received by domestic oil producers, but it would allow the controlled price of newly discovered oil to rise over three years to the 1977 world price with subsequent adjustments for domestic inflation. This price would offer substantial incentives to increase production of domestic oil, but actual increases in production are likely to be relatively small. CBO estimates that the rise in price for newly discovered oil would increase production by about 100,000 barrels a day by 1985; the Administration's estimate of increased production is slightly higher.

To discourage consumption of oil, the plan would raise prices paid by domestic consumers to world levels by imposing a "crude oil equalization tax" equal to the difference between world and domestic prices. This tax would capture for the public the windfall profits associated with higher prices on already discovered oil and would return those profits to consumers in the form of rebates.

The equalization tax on crude oil will increase the price of petroleum products by an estimated 4 to 5 cents per gallon (in current dollars) by 1980; this amount is in addition to the increase of 4 to 5 cents per gallon projected under existing legislation. The tax would also lead to the elimination of the so-called "entitlements program," and would thereby reduce some of the regulatory burden on the industry. The equalization tax appears to be an effective mechanism for equalizing foreign and domestic oil prices and capturing windfall profits. It would provide a slight incentive for consumers to reduce consumption or convert to alternative sources. Proposed user taxes on oil provide additional incentives for industry and utilities to convert to coal.

Natural Gas Pricing

The pricing proposal for natural gas eliminates the current distinction between interstate and intrastate markets by placing all gas under federal jurisdiction; it places a cap on the price of new gas at \$1.75 per thousand cubic feet. In addition, a special excise tax is placed on use of natural gas by industries and public utilities. The purpose of these proposals is three-fold:

- o To protect residential consumers against high prices and shortages,
- o To make gas expensive for industries that can convert to coal, and
- o To increase new supplies but reduce the possibilities of producers' gaining excessive profits on previously discovered gas.

With the exception of the degree of coal conversion, CBO finds that the natural gas proposals will attain the stated objectives. The proposals would generally reallocate the existing supplies of natural gas; no energy savings would therefore be attributable to this proposal according to either the Administration or CBO.

Coal Conversion

Since the goal for conversion of utilities from oil and gas to coal is generally consistent with current trends, CBO concurs with the Administration's conversion estimates in this area. A major discrepancy exists, however, in estimates of the likelihood of attaining the goal for industrial conversion. If present policy were continued to 1985, only 12 percent of new industrial demand would burn coal. The President's plan envisions that industrial consumption of coal would more than double by 1985. Accomplishing the Administration's goal would require that 10 percent of all existing oil and gas used for industry be converted to coal and that 44 percent of all new potential users would convert to coal. This report agrees with the President's 10 percent conversion of existing industrial use but projects only 33 percent of new uses to be converted to coal. (The reasons for this lower estimate include the logistics of transporting coal, concerns about protecting the environment, and problems of scheduling new coal facilities to maximize the benefits of rebates,

all of which will impede new conversion.) This would result in total coal consumption by industry of 360 million tons by 1985--50 million tons below the Administration's estimate.

In terms of equivalents in barrels of crude oil, CBO's estimate translates into a savings in imported oil of 1.8 million barrels a day, which is 0.6 million below the Administration's figure. To some extent, however, the attainment of the goal would depend upon the future actions of the Administration since it could control both the specification of coal regulations and their subsequent enforcement.

Auto-Related Proposals

The automobile-related provisions of the President's energy package are aimed at reducing gasoline consumption through production and sales of vehicles with greater fuel efficiencies, and through price-induced reductions in the number of miles driven. The goal of the plan is to reduce total gasoline consumption by 10 percent from current levels by 1985. This is an ambitious goal, considering that motor gasoline consumption has increased at 4.5 percent per year between 1965 and 1975, but its attainment would be aided substantially by existing legislation. In particular, the Energy Policy and Conservation Act of 1975 set fuel economy standards for new cars under the threat of civil penalties. While CBO does not expect these standards to be met in every year, it does anticipate that they would have significant effects on automobile gasoline use. In 1985, holding it within one percent of the present level. CBO estimates that adoption of the President's plan would reduce automotive gasoline consumption further, but to 5 percent beneath its present level, not 10 percent below as projected by the Administration.

Three programs in the President's plan contribute to gasoline savings. More than half of the savings come from the President's proposed "gas-guzzler" taxes and rebates based upon a new car fuel economy. This program is estimated to yield fuel savings of 215,000 barrels a day in 1985. Second, standby gasoline tax could be triggered as early as 1982 according to CBO projections, and assuming that it is triggered then, it would produce gasoline savings of 65,000 barrels per day in 1985. Finally, the crude oil equalization tax is expected to contribute an additional 25,000 barrels a day of gasoline savings in 1985. Taken together, these three programs would yield total gasoline savings of 305,000 barrels a day in 1985, less than a tenth of the energy savings produced by the President's plan as a whole.

CBO's estimate of the fuel savings for the gas-guzzler excise tax and rebate program is slightly higher than the Administration's, and the Administration has not yet computed comparable estimates for the standby gasoline tax and crude oil equalization tax. The Administration has indicated, however, that without the standby gasoline tax, 1985 gasoline consumption would be 350,000 barrels per day above target. While CBO expects that 1985 gas consumption would most likely exceed the target by more than this, the excess above target in both sets of projections is greater than the estimated 65,000-barrel savings of the standby gasoline tax, implying that the President's goal of a 10 percent gasoline reduction by 1985 appears unlikely.

Future gasoline consumption by trucks introduces considerable uncertainty as to whether or when the President's goal would be met. At present, trucks account for more than 20 percent of the nation's gasoline consumption, and their future share of gasoline use could rise if their fuel economy improvement does not keep pace with that of autos. The fuel economy of light trucks is expected to improve as a result of existing legislation as well as through the President's gas-guzzler proposal as it would apply to light trucks. But both existing and proposed legislation in this area are keyed to a set of standards that have not yet been specified, so that assessment of their conservation impact is impossible at this stage. CBO analysis indicates that these future developments in the fuel economy of trucks would have a major effect on the triggering of the standby gasoline tax, and could delay it from 1982, as projected above, to 1983 or 1984. Policies related to trucks play a key role in shaping an effective and even-handed policy for transportation fuel conservation.

Insulation Tax Credit

The proposed insulation tax credit is likely to encourage some additional homeowners to upgrade the insulation in their homes. With sharp rises in fuel prices since 1973, however, many homeowners have already reinsulated or have decided to do so in the future. For example, about 3 million homeowners chose to upgrade their insulation in 1976. With current energy prices, insulation is already a good investment since the savings in fuel bills are about three times the cost of the insulation. The proposed credit would increase this ratio of savings to cost to 4 to 1.

Between now and 1985, an estimated 24 million homeowners and renters are likely to reinsulate their dwellings. CBO estimates that nearly 8 million of the 24 million would be an increase attributable to the tax credit. The 24 million translates into a total of 70 percent of all residential homeowners as opposed to the 90 percent projected by the President. CBO estimates the energy savings attributable to these nearly 8 million households would be approximately 120,000 barrels of oil a day.

The Administration, on the other hand, estimates that a savings of 480,000 barrels would be due to the credit and related programs. The major difference is that CBO estimates that an additional 280,000 barrels a day will be saved by re-insulation that people would do anyway without the Carter plan, adding up to a total of 400,000 barrels per day from all insulation. The Administration assumes that a total of 480,000 barrels a day savings would be induced by the plan.

Short-Run Impacts on the Economy

President Carter's package would have a major impact on energy markets, a noticeable but small impact on the overall rate of inflation, and only a minor impact on total output and employment. CBO estimates that the President's plan would add about 1.6 percent of the level of consumer prices by 1980 or about half a percentage point a year to the rate of inflation from 1978 through 1980. The output effect is estimated to reduce constant-dollar gross national product by no more than 0.7 percent by the end of 1980, thus adding 0.2 percent to the unemployment rate. These estimates do, however, assume that there will be no new investment for conversion during the next two years. The total impacts on unemployment and real growth could therefore be partially offset if additional investment is forthcoming.

Distribution Effects

A final issue addressed in this study is the combined impact that the energy proposals and tax rebates would have on various groups of Americans. Assuming that the various taxes would be passed on to consumers almost entirely, close to \$13 billion would be paid by 1980 (in 1977 price levels) in higher energy prices.

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In addition to this total effect, the energy proposals would redistribute purchasing power from persons in the upper three income quintiles to the two lowest quintiles in 1980 and from the upper three quintiles to the lowest two in 1985.

Other shifts are likely to take place as well. For example, people who do not own automobiles would gain at the expense of automobile owners. Homeowners would gain at the expense of renters, and city dwellers with access to public transportation would gain at the expense of persons in suburbs and rural areas.

CHAPTER I. SCOPE OF THE REPORT

President Carter's energy proposals focus on one of the most critical issues to be debated by the 95th Congress. They address a problem that has become progressively acute and then promises to get still worse. If the proposals are enacted, they will affect every household and business in the United States. It is essential, therefore, that the Congress be able to debate the major issues and decisions quickly.

This working paper is intended to assist in the Congressional debate by offering an independent evaluation of the proposed energy program. Because of the timing of this response, however, its scope must be restricted. Accordingly, the report focuses on the major energy initiatives of coal conversion, the crude oil equalization tax, natural gas pricing, home insulation and solar equipment tax credits, and the two automobile-related proposals. Secondary proposals, such as standards on new appliances and buildings, which altogether the Administration estimates account for less than 30 percent of the potential savings, are not addressed in this report.

Essentially, the paper has five major objectives:

- o To give an overview of the general strategy,
- o To provide analysis of the major initiatives,
- o To convey information about the incentive mechanisms,
- o To indicate short-run macroeconomic impacts, and
- o To specify possible changes in the distribution of income.

Chapter II offers a general orientation, describing the overall philosophy of the President's approach and its critical features, and placing it in the spectrum of possible alternatives. Perhaps more important, however, it specifies a framework for evaluating the individual proposals that is used throughout the subsequent chapters. Chapters III through VII evaluate and analyze the major energy initiatives within the package. Chapters VIII through X attempt to assess the general costs and benefits of the major proposals. Budget costs, macroeconomic effects, and distributional impacts are addressed in these final three chapters.

CHAPTER II.

A GENERAL ORIENTATION

The President's energy plan contains a variety of interlocking pricing policies, regulatory mechanisms, and administrative actions designed to accomplish two goals: to reduce the nation's reliance on imported oil, and to speed the transition toward an economy that consumes less energy. This chapter presents an overview of the general direction of the plan, contrasting its emphases with those of alternative approaches. It outlines the principal costs and benefits of the plan; it also examines some general characteristics of the nation's consumption of energy, which must be understood in order to develop a balanced and effective energy policy.

THE PRESIDENT'S STRATEGY

Artificially low prices for oil and natural gas have contributed to putting the United States in a precarious position. The complex system of controls on oil and gas prices now in force in the United States has kept the domestic price of these fuels below world levels. This regulatory system has cushioned Americans against the dramatic changes in consumption, and in turn lifestyles, that might have been caused by the abrupt quadrupling of oil prices by the cartel of Oil Producing and Exporting Countries (OPEC) in 1973 and 1974. Artificially low prices have also tended to encourage energy consumption however, and to discourage the search for and production of new domestic resources. The indirect effect, therefore, has been to increase our dependence on foreign suppliers. With energy consumption continuing to grow, and proven reserves of oil and natural gas not keeping pace, the potential impact on the United States of another disruption like that of the OPEC oil embargo of four years ago is great.

To solve the problem that has been partly caused by these artificial energy prices, the Administration has put forth three major strategies:

- o Reduce the long-term growth in energy demand by imposing various excise taxes to raise the price of petroleum and related products to world or near world levels. New regulatory standards are also proposed and special efforts are taken to reduce the growth in demand for gasoline.
- o Shift large industries and utilities to burning coal (of which domestic supplies are abundant) instead of oil or natural gas by taxing the use of the latter two fuels. Regulations are designed to prohibit most new industrial and utility use of oil and natural gas.
- o Promote the increase of domestic supplies by reintroducing market pricing, or near market pricing, for truly new supplies of oil and natural gas.

An underlying theme of President Carter's program is that the transition to a less energy-intensive economy is a long and complex process. Incentives set in motion now to alter consumption patterns and investment decisions will begin to yield significant savings only after a few years. Genuinely large-scale energy savings will not begin to show up until the middle of the next decade.

To avoid uncertainties about future shortages and disruptions, however, major changes in incentives and in patterns of energy use may have to start now. A clear set of signals with respect to future energy prices is essential. Future price uncertainties must be minimized; this, in turn, should encourage both consumers and businesses to begin the long, gradual process of changing their capital purchases to reflect higher energy prices over the long term. Use of a more efficient capital stock should substantially curb the growth in energy demand.

Market incentives are not the only consumption-curbing devices in the Administration's program. The plan also uses taxes to capture most of the windfall gains that would otherwise go to energy-producing industries and returns these tax revenues to the public by means of a system of rebates. Higher prices for energy are phased in over several years, and fuels

for certain uses (e.g., home heating) are effectively excluded from the price increases. The use of gasoline is particularly discouraged, as is the use by large industrial consumers and utilities of oil and natural gas instead of coal. Certain direct monetary inducements are offered for particular types of energy conservation (e.g., home insulation). And, regulations are designed to reduce consumption in other areas (e.g., home appliances).

Producers of oil and natural gas are allowed price increases of 20 to 30 percent for truly new production and for tertiary recovery (i.e., third-time use of a given well), and prices are protected from future domestic inflation. Should the rate of growth in world prices exceed the rate of domestic inflation, oil prices received by domestic producers will be limited to the growth in the general inflation rate. Thus, future actions of OPEC will not necessarily determine prices charged by domestic producers, but unless they are excessive, future OPEC actions will affect prices paid by American consumers.

ALTERNATIVE APPROACHES TO NATIONAL ENERGY POLICY

In view of the numerous, highly specialized components required in a national energy plan, there can be many alternative programs. While the number of combinations of elements is limitless, there are three general directions against which it is useful to compare the President's plan:

- o Set more ambitious conservation goals,
- o Rely more heavily on free market mechanisms to increase supply of oil and gas, or
- o Undertake crash programs for new technologies.

More Ambitious Conservation Goals

The belief that a severe energy crisis is close, or the belief that the hazards to the environment and to health associated with a continuation of present levels of energy consumption are unacceptable, might lead one to advocate more ambitious conservation goals than those put forth by President Carter.

Energy conservation is to be brought about largely by gradual changes in the type and efficiency of consumer durable and of producer's investment goods. Such changes would inevitably be slow. Therefore, the argument goes, in order to have any real impact, a program must set more ambitious goals.

The implementation of such a strategy might involve either a more complete and less gradual reliance on the price mechanism; alternatively, it might involve direct controls and regulations. If the latter approach were followed, production subsidies might be required. The immediate sacrifices required of both individuals and businesses would be greater than those called for by the President's plan.

Greater Reliance on Market Mechanisms

Underlying the free market emphasis is the belief that government intervention in energy markets distorts the desired economic signals to both consumers and producers. The logic of this approach is that, if domestic production is inadequate and dependence on imports too great, domestic prices should be allowed to rise to stimulate new production; presumably, this increased production would boost the demand otherwise inhibited by higher prices. In fact, to a large extent this is the approach of the President's plan, but mainly on the demand reduction side. Rather than extending the incentives of higher prices to potential producers, the plan uses taxes to raise prices to consumers--and continues many price controls.

Opposition to extending the market approach has developed on several grounds. First, the OPEC cartel is just that, a cartel. The prices it sets do not necessarily imply "market justice." Second, opinion varies widely about the ability of the U.S. resources to meet domestic energy needs--even if prices were allowed to rise to world levels. Many experts believe that freeing prices from all controls would yield little additional domestic supply; others contend that higher prices could induce both the discovery of new resources and substantial additional production from existing reserves. Third, there are questions about the extent of economic disruption that the higher prices would cause. Finally, feeling among Americans is widespread that the producers are not entitled to the large windfall profits associated with higher prices.

Crash Programs for New Technologies

A crash program for new energy technologies is often compared with the Manhattan project, which developed the first atomic bomb, or with the Apollo program, which succeeded in landing a man on the moon. In both of these programs, massive federal funding was used to accelerate the research, development, and demonstration (termed R, D, and D) process. Some observers argue for a similar program in the energy field, focusing efforts on new energy technologies and on attempts to reduce the health and safety risks of known technologies, especially those involving plutonium and the completion of the nuclear fuel cycle.

It is probably true that massive new federal spending (beyond the \$3 billion allocated to the Energy Research and Development Administration--ERDA--in 1977) would accelerate the R, D, and D process. But even the most optimistic scientists indicate that new technologies could not be developed and adopted before 1990. Consequently, in the short to intermediate term, the crash program appears not to be a reasonable substitute for a conservation plan.

BENEFITS AND COSTS OF THE NATIONAL ENERGY PLAN

The President and members of his Administration credit the national energy plan with several major benefits, among them reduced reliance on imported oil, an orderly transition toward an energy scarce economy, and insulation from future energy shocks. The Congressional Budget Office is in general agreement that the plan would make progress toward achieving these benefits. In some important instances, however, CBO's numerical estimates of savings and related magnitudes are smaller than the Administration's.

Reduced Reliance on Imported Oil

The principal benefit attributed to the President's energy plan is that it would reduce U.S. dependence on oil imports. The Administration estimates a reduction of 4.5 million barrels a day by 1985; CBO estimates are closer to 3.6 million barrels per day. Even in the lesser case, however, such a reduction in imports is translated into a reduction in the economic and national security risks associated with a critical natural

resource, the supply and price of which may be dictated by an international cartel. Not only does the Administration's program offer some insulation from both short-run supply interruptions and long-run curtailments; it may also increase the ability of the United States to exercise some influence over the OPEC price.

Smooth Transition to an Energy Efficient Economy

A principal potential benefit of the plan is that it will help steer an orderly transition from what now appears to be an energy-rich economy to one that is generally expected to be more energy-poor. Since the use of energy is closely tied to the efficiency of equipment in factories and farms, the transition to a less energy-intensive economy involves considerable time while capital stock is replaced with energy-efficient substitutes. A gradual move toward greater efficiency, as opposed to a crash program at some later date, will help prevent excessive capital losses by individuals or businesses, and will help to avoid general economic disruptions.

Insurance Against Future Energy-Shock

Because there is so much uncertainty about energy futures, the President's energy plan can be viewed as a type of insurance policy. By reintroducing market or near-market price incentives for both consumers and producers, the plan attempts to discourage consumption and encourage domestic production, thereby reducing doubts about the ability of the U.S. economy to survive any energy crisis that may develop.

Costs Of the Plan

The Administration's energy policy would also impose several major costs on the nation, however. First, modes of living and working are likely to change as a result of higher fuel prices and therefore many people may be inconvenienced.

Second, many individuals and businesses may incur capital losses on their consumer durables and investment goods that are inefficient in energy use and that become obsolescent.

Third, the macroeconomic effects would be small but noticeable. If the President's plan is enacted, the rate of inflation is expected to increase by an annual rate of about 0.5 percent over the next several years. The growth rate of the gross national product (GNP) is likely to be slowed slightly and the unemployment rate increased by a small amount. If increases in the demand for new (energy-efficient) investment goods is only slightly larger than anticipated, however, this increase could more than wipe out the expected GNP and employment losses, making the macroeconomic impacts of the President's plan negligible.

Fourth, although the plan would use rebates to cushion the losses in purchasing power associated with the overall increase in energy prices, these rebates would not be distributed evenly. Families in upper-income classes would generally pay a higher absolute amount of their incomes for energy, while lower-income families would receive a disproportionately large share of the rebates. Any individual's automobile ownership and place of residence, however, would produce a different effect.

THE PRESIDENT'S PLAN IN CONTEXT

Before analyzing individual programs within the President's plan, it should be helpful to examine several features of the plan as a whole in the context that surrounds it. Specific features include:

- o The differences between the President's plan and his proposed energy act,
- o The expected future growth in petroleum consumption,
- o The nature of the much-discussed "sacrifices,"
- o The importance of regulatory measures,
- o The interdependence of proposals within the plan, and
- o The timing of costs and benefits.

The Plan and the Proposed Legislation

A key feature of the President's energy plan is that the goals and energy savings incorporated into it may not be fully achieved by the National Energy Act as introduced. While the Administration hopes that the act will attain the stated goals, it recognizes that this hope may not be realized and that additional legislation or regulations may be required later. Indeed, the Administration seems to be viewing its plan in two stages: the initiative contained in the proposed act first, then more severe measures if the legislation does not accomplish the specified goals. Many of these more severe measures are included in the plan, but are not incorporated into the legislation now before the Congress.

The potential gap between the energy savings of the plan and the act depend significantly on a number of additional regulatory decisions, such as exemptions from mandatory coal conversion, over which the Administration would have control. Strict enforcement would increase the probability that the goals would be attained. Consequently, the commitment of the Administration to the goals is critical in determining the efficacy of the overall plan.

Energy Savings and Rising Consumption

Because the nation's population is expected to grow and the standard of living is expected to rise, the nation's use of energy in 1985 is anticipated to be 30 percent greater than it was in 1976 if present policies and practices continue. Similarly, the nation's use of petroleum products in 1985 is projected to be almost 23 million barrels per day--again, about 30 percent greater than it was in 1976. While the President's plan would reduce this petroleum use (by 3.6 million barrels per day according to CBO estimates and by 4.5 million barrels per day according to the Administration), the reliance of the United States on petroleum in 1985 will, in absolute terms, still be greater than it is now. Thus, the savings reflect reduced growth in energy consumption, rather than absolute declines. This should be kept in mind, since all the estimates of energy savings provided by the President's plan are analyzed relative to expected outcomes under present policy, that is, assuming the extension of the Energy Policy and Conservation Act (EPCA) through 1985. Although both CBO and the Administration have worked with this baseline,

savings would be overestimated if, in fact, EPCA were not extended and prices were allowed to approach the world market levels after 1981.

The "Sacrifices"

Much of the discussion of the plan describes reductions and substitutions in consumption that will be made by the American people in response to the President's plan. By and large, these adjustments are really slowdowns in the rate of the rise of the standards of living between now and 1985. But even with the rate slowed, the standard in 1985 would still be higher than it is now. For example, the average American family now drives slightly less than 15,000 miles per year. Under the plan, they would likely drive 17,000 miles in 1985, which is more than they drive now even though it is less than the 18,000 miles they would drive without the plan.

Regulatory Measures

The major thrust of the President's package appears to be one of increasing energy prices to consumers so that they will make their normal market adjustment of decreased consumption. But, a relatively high proportion of the estimated energy savings comes from the implementation of new standards on appliances, on new commercial and residential buildings, and so forth. These features represent an extremely important part of the program.

Interdependence of the Proposals in the Act

The plan embodies a set of proposals that are very interdependent. To a large degree, there is a "carrot and stick" philosophy. An example of this principle is the extension of tax credits to industry. Firms, which would already benefit to some extent from raising the prices of their products, would be further induced to increase their output of energy-efficient items by the reward of a tax credit. The importance of this reward would rise over time as increased costs threatened to erode profits. Taken one by one, either of these two proposals might yield only marginal energy savings, but combined, the effect may be substantial.

Timing of Costs and Benefits

Finally, the costs of the plan--higher taxes and the like--would begin immediately upon adoption, but most large-scale benefits would not become apparent until the latter part of the next decade and beyond. Further, like many national defense expenditures, the benefits are likely to accrue to the nation as a whole and not necessarily to individuals. The costs, however, are likely to be experienced first, more directly, and by more people.

CHAPTER III. THE CRUDE OIL PROPOSAL

The President's proposals on crude oil pricing are intended to accomplish several objectives:

- o to increase incentives for domestic oil production by raising the price received by producers of newly discovered oil;
- o to prevent the petroleum industry from gaining windfall profits on already discovered oil;
- o to discourage consumption of crude oil by raising the prices paid by domestic consumers to world levels;
- o to discourage consumption further by imposing a tax on industrial and utilities users of petroleum products.

The plan would retain controls on prices received by domestic producers of oil, although it would allow the controlled price of newly discovered oil to rise. It would raise the price of oil paid by consumers to the world level by imposing "a crude oil equalization tax" equal to the difference between world and domestic prices.

Incentives for new production under the plan are where they would be most effective--on newly discovered oil. Although domestic production costs are high, the producer revenues permitted for new oil would be among the highest in the world. In addition, large users of petroleum would be taxed in order to encourage them to convert to coal. The revenues from the tax would be available as rebates to be used to defray the costs of conversion. This chapter projects the total revenues of the tax while the success of this tax on coal conversion is addressed in Chapter V.

The conclusions presented in this chapter are that the equalization tax is an effective mechanism to equalize crude

oil prices and capture the potential windfall profits. It also will lead to elimination of the entitlements program and thereby reduce some of the regulatory burden on industry. The crude oil equalization tax also increases prices to consumers by between \$0.4 and \$0.5 per gallon (in current dollars) over the increase that would occur under current legislation between 1978 and 1980, thereby providing a small incentive to consumers to reduce consumption or convert to alternative energy sources.

With respect to the effects of the plan on energy supply and demand, CBO is close to the projections claimed by the Administration. Production is likely to increase as projected, although somewhat less than forecast by the Administration. Furthermore, the plan effectively reduces pricing inequities, and increases producer incentives relative to present policy. The nation would be in a decidedly better economic position during the 1980s if the Administration's crude oil proposals were implemented than it would be with a continuation of present policies.

PROPOSED POLICY

The crude oil pricing proposals are particularly relevant to the Administration's conservation objectives because the current regulation of domestic crude oil prices contribute to continually increasing consumption. Most domestic oil is currently priced well below the world market price which represents the replacement cost of oil to this country. Existing legislation limits the price of lower- and upper-tier oil to \$5.25 and \$11.28 per barrel respectively. ^{1/}

Under the Administration's pricing proposals, the price of previously discovered oil (discovered prior to April 20, 1977) would remain subject to price controls, but the controlled price would be allowed to increase at the general rate of inflation. The price of oil discovered after April 20, 1977 (called

1/ Lower tier prices apply to oil produced from wells that were in operation during 1972 or prior; while upper-tier prices apply to new oil from wells that were completed after 1972, but prior to April 20, 1977. The definition of new oil also encompasses increased production from old wells (production above the "decline rate").

"newly discovered" oil) and oil from tertiary recovery from existing wells will be allowed to rise over a three-year period to the 1977 world price, adjusted for inflation.

Should the rate of growth of world prices exceed the rate of domestic inflation, however, domestic oil prices paid to producers would be limited to the growth in the domestic price level. Thus, future OPEC actions would not necessarily determine prices received by domestic producers.

From the consumers' point of view, the most important facet of the Administration's crude oil pricing proposals is that the price of domestic crude oil will be raised to the world price level. The mechanism by which this price increase is achieved is a crude oil equalization tax which is applied to all domestically produced oil in three stages, so that by the end of the third year, the price paid for all domestic oil is equal to the world price. The first tax would go into effect on January 1, 1978. It would increase the price of lower-tier oil by \$3.50 in nominal terms, or by about half the difference between its level and the upper-tier level. The second stage (January 1979) would equalize all controlled domestic production at the upper-tier level and the last stage would move all domestic prices to the level of world prices.

Thus the American consumer of crude oil would pay the world price of oil, not the present artificially low price. To keep the American consumer from being totally at the mercy of the pricing decisions of an international cartel, however, the plan provides that the rate of price increase can be controlled to match the rate of domestic inflation.

ENERGY IMPACTS

In order to evaluate the proposals related to crude oil pricing, two possible cases have been constructed. The first--the present policy case--assumes that the pricing provisions of the Energy Policy and Conservation Act (EPCA) of 1975 and the Energy Conservation and Production Act (ECPA) of 1976 continue in effect indefinitely. The alternative case represents the President's proposals.

The major impacts of the crude oil proposals are summarized in Table III-1. All prices are expressed in 1977 dollars. As shown in the table, the President's proposals will affect both the price and amount of crude oil which will be available to consumers.

TABLE III-1. PROJECTED COMPARISON OF PRICES AND QUANTITIES OF OIL a/: PRICES IN 1977 DOLLARS PER BARREL: QUANTITIES IN MILLIONS OF BARRELS PER DAY

	1977	1980		1985	
		Present Policy	Carter Plan	Present Policy	Carter Plan
Quantity of Oil Demanded	17.9	19.7	18.9	22.8	18.9 <u>b/</u>
Average Price per Barrel	\$11.56	\$12.67	\$14.69	\$13.55	\$14.69

SOURCE: Congressional Budget Office.

a/ Prices are refiner acquisition costs and are equal to about \$0.35-\$0.45 per barrel more than wellhead prices. Quantities are in barrels of refined products and therefore the totals are about 0.4 million barrels per day above the demand equivalent crude oil.

b/ This is a minimum estimate. Since this report did not address all the parts of the President's proposals, it is possible that actual petroleum demand will exceed this number.

Prices of Petroleum

The 1980 prices for the various sources of crude oil that would be charged under the two cases described above are shown in Table III-2. These prices are refiner acquisition costs as defined by FEA and are about 40 cents per barrel above the wellhead costs. The prices also are national aggregates and therefore take no account of sulfur content, gravity, viscosity, or location.

The assumptions on which the present policy prices are based is that price controls under the terms of EPCA are continued indefinitely, allowing for an increase in real crude prices of 2.5 percent per year.

The prices established for the President's proposals are based on the assumption that: wellhead prices of upper- and lower-tier oil and natural gas liquids would be held constant in real terms; a tax (of about \$3.29 per barrel in 1977 terms) would be imposed on lower-tier oil in 1978 and would be doubled in 1979, in order to bring lower-tier oil up to the level of upper-tier oil; and that all domestic oils would be taxed to bring their prices up to world levels starting in January 1980.

An important assumption in the CBO analysis of the President's plan is that the price of imported oil rises at about the same rate as inflation. If the price were to increase faster than inflation, there is a provision in the President's crude oil proposals to limit prices to a level below the world price. If world prices fall, there is no provision proposed to support domestic prices; thus they would fall accordingly.

As a result of the proposed pricing policies, the average price of domestic and imported crude oil paid by refiners in 1978 would be about \$0.95 per barrel (8 percent) greater than it would be under present policy. By 1980, the difference would be about \$2.00 per barrel (16 percent).

The crude oil equalization tax would be rebated to consumers. This mechanism and its impacts on the consumers are discussed in Chapter X. In 1980 the total amount of tax revenues should be about \$15.8 billion in 1977 dollars. This estimate assumes that taxes would be collected on 7.3 million barrels per day of domestic crude. In 1985, the tax revenues would be about \$11.2 billion on 5.4 million barrels per day.

TABLE III-2. PROJECTED CRUDE OIL PRICES a/: IN 1977 DOLLARS
PER BARREL

	1977	1980		1985	
		Present Policy	Carter Proposal	Present Policy	Carter Proposal
Lower Tier	5.65	5.65	14.69	5.65	14.69
Upper Tier (to 4/20/77)	12.05	13.72	14.69	14.69	14.69
Newly Discovered (after 4/20/77)	12.05-12.71 <u>b/</u>	13.72	14.69	14.69	14.69
Stripper Wells	14.69	14.69	14.69	14.69	14.69
Alaskan North Slope	12.05-14.69 <u>b/</u>	14.69	14.69	14.69	14.69
Naval Petroleum Reserves	12.05	13.72	14.69	14.69	14.69
Special and Ter- tiary Production	14.69	14.69	14.69	14.69	14.69
Natural Gas Liquids	8.33	8.33	14.69	8.33	14.69
<hr/>					
Total Average (including imports)	11.56	12.67	14.69	13.55	14.69

SOURCE: Congressional Budget Office.

a/ These are prices paid by refineries after transportation costs. Wellhead prices are about 35 to 45 cents lower, except in the case of Alaskan oil.

b/ The lower figure is for the Current Policy Case, the higher is for the Carter proposal.

Prices of Refined Products.

Refineries produce literally dozens of products; however, the primary products are gasoline, diesel fuel, distillates (home heating oil), and residual fuel (industrial fuel oil). The present and future prices of these fuels under the two cases are presented in Table III-3.

Administration estimates indicate that if domestic oil prices are increased to world levels in 1980, only two-thirds of this increase will be passed through to consumers in the form of higher prices. The Administration believes that approximately one-third of the higher price would be absorbed in the profits of refiners. This would result from the fact that the lower price on imported refined products charged by some foreign refiners would tend to exert a downward pressure on domestic prices.

Unfortunately, little solid evidence is available to support any assumption on the magnitude of the price increase which will be passed on to consumers. ^{2/} In the view of the Congressional Budget Office, the two-thirds assumption is very optimistic. Our estimates are based on the assumption that virtually all of the tax will eventually be passed through to consumers.

^{2/} The Administration projects that several prices of refined products will be limited by international market prices, just as is residual fuel. This analysis agrees that such is possible particularly with respect to heating oil in New England and the Mid-Atlantic regions. However, competition with refined imports is not expected to be an important factor in other regions or with other products. This projection has been made because the price differences are small domestic refineries are very efficient producers of all products other than residual fuel, and existing transportation systems favor domestic refineries. The home heating oil rebate will reduce the competitive position of foreign refiners further.

TABLE III-3. PROJECTED PRICES OF REFINED PRODUCTS: CENTS PER GALLON; IN 1977 DOLLARS

Products	1977	1980		1985	
		Present Policy	Carter Plan	Present Policy	Carter Plan
Gasoline (Unleaded regular at the pump, full service stations)	65.5	68.5	73.5	71.0	73.5
Diesel Fuel (No. 2 at truckstops)	55.0	58.0	63.0	60.5	63.0
Distillates (Retail)	44.0	47.0	46.5	49.5	48.0
Residual Fuel (Retail)	29.0	29.0	29.0	29.0	29.0

SOURCE: Monthly Energy Review, March 1977, Federal Energy Administration, pp. 12-20, 58-69, 79, and Congressional Budget Office estimates.

The proposed crude oil equalization tax is, in general, an effective mechanism for raising consumer prices of petroleum products to equal their replacement costs (i.e., imports) without allowing the producers to collect windfall profits; however, some regulatory problems will continue.

- o Definition of which specific types of oil receive what price will remain an issue as long as the definitions determine the price.
- o Some incentive will remain for producers to reduce production from old wells so that they can receive the higher stripper oil prices.
- o If world prices change rapidly, in either direction, executive decisions might be necessary to maintain prices.

As Table III-3 indicates, the prices of gasoline, diesel fuel, and home heating fuels will rise in real terms in both cases, but that by 1980 the prices estimated under the President's proposals will more than double the increase expected under present policy. The prices of residual fuels, however, will not rise, because they are dominated by international market prices. Slightly over 50 percent of the residual fuel consumed in this country is imported. Almost 70 percent of this residual fuel is consumed where the price is largely determined by the price of imports. The assumption in this chapter is that international prices do not increase in real terms over time and therefore residual fuel prices are projected to be constant through 1980. Domestic refiners will, therefore, allocate their increased costs of residual fuel to other products.

Consumption of Petroleum

In Table III-4 the effects of the President's proposals on consumption of refined products are displayed. As a result of the crude oil equalization tax, the automobile related proposals, the insulation tax credit and the coal conversion program, consumption in 1980 would be 4 percent lower in the President's plan than under present policy. By 1985 the difference is estimated to be 17 percent. Because the crude oil equalization tax would operate in tandem with many of the other proposals within the plan, however, no independent estimates are made of this particular proposal.

Generally, the impact of all the proposals by 1980 is uniform among the sectors--the Carter plan decreased consumption in each sector in comparison with a continuation of present policy. The plan would decrease consumption in the residential and commercial sector in absolute terms. After 1980, the plan would also lead to the reduction of the amount of oil used by electrical utilities.

An important point in this regard is that the industrial consumption of oil continues to grow from present levels in both cases. Under the President's plan, industrial consumption in 1985 is 44 percent above consumption for 1977. This implies an average annual growth rate in the industrial sector of 4.6 percent per year. By 1985, however, the number of industrial

TABLE III-4. PROJECTED CONSUMPTION OF REFINED OIL PRODUCTS:
IN MILLIONS OF BARRELS PER DAY

	1977	1980		1985	
		Present Policy	Carter Plan	Present Policy	Carter Plan
Residential/Commercial (90 percent distillate)	3.4	3.4	3.3	3.2	2.8
Industrial (70 percent residual)	3.2	4.2	3.8	7.0	4.6
Transportation (70 percent gasoline)	9.7	10.3	10.2	10.6	10.2
Utilities (90 percent residual)	<u>1.6</u>	<u>1.8</u>	<u>1.6</u>	<u>2.0</u>	<u>1.3</u>
Total Refined Products	17.9	19.7	18.9	22.8	18.9

Equivalent Amount of Crude Oil	17.5	19.2	18.4	22.3	18.4

SOURCE: Congressional Budget Office.

boilers burning oil would decline, whereas consumption of petroleum as feedstocks would continue to expand.

Since most of the oil price increases in the residential sector will be rebated, the President's plan will not substantially affect residential consumption of oil. However, implementation of the home insulation tax credits would reduce consumption in this sector. But because increased use of insulation is cost-effective, with or without the proposed tax credit, demand for residential fuel would decline after 1980 in both cases.

The largest use of petroleum is for transportation. As is explained in Chapter VI, demand for all fuels for transportation expand slowly in both cases, but reach a plateau in the early-1980s under the President's proposals. Demand for gasoline for automobiles may then start declining between 1982 and 1984.

The Petroleum User Tax

The Tax On Industry. The President's plan proposes a tax on industrial consumers of petroleum products that would go into effect in 1979. A similar tax on utilities would be implemented in 1983. The user tax is graduated according to consumption, so that consumers of less than 500 billion BTU of oil per year pay no tax and consumers of more than 1,500 billion BTU pay tax on their entire consumption.

The tax is planned to start at 95 cents per barrel of residual fuel oil and 87 cents per barrel of distillate. The tax doubles in 1980 and then rises each year to \$3.15 and \$2.90 for residual and distillate respectively by 1985. In terms of real change, the tax increases fuel prices to industry by 12.9 percent in 1980 and 21.5 percent in 1985 relative to a price without the tax. The price and revenue impacts of the user tax on industry are displayed in Table III-5.

The costs of using petroleum in new plants are already higher on a BTU basis than competing coal prices. Thus it is doubtful whether the user tax provision taken alone would influence many consumers to convert to coal. Perhaps more important than the negative incentive of the user tax is the positive incentive of the proposed rebate provision for new industrial investment for conversion to coal.

Industry is eligible under the President's plan for either an additional 10 percent investment tax credit for expenditures to convert to coal or a rebate of user taxes (on either natural gas or petroleum) for the amount of expenditures incurred during conversion. In order to encourage accelerated investment in conversion, there is a carry-forward provision in the proposed tax amendment which would enable industry (and in later years, utilities) to accumulate credits in advance which could be used later to reduce the tax.

TABLE III-5. THE INDUSTRIAL USER TAX: IN 1977 DOLLARS

	Quantity Consumed <u>a/</u>	Approximate Taxable Use <u>a/</u>	Average Price Before Tax <u>b/</u>	Price After Tax <u>b/</u>	Revenue <u>c/</u>
Revenue in 1980					
Residual Fuel	2.66	2.39	12.15	14.05	1.7
Distillates	<u>1.14</u>	<u>0.68</u>	<u>22.26</u>	<u>24.00</u>	<u>0.4</u>
Total	3.80	3.07	14.40	16.26	2.1

Revenue in 1985					
Residual Fuel	3.22	2.90	12.15	15.30	3.3
Distillates	<u>1.38</u>	<u>0.83</u>	<u>22.26</u>	<u>25.16</u>	<u>0.9</u>
Total	4.60	3.73	14.40	17.50	4.2

SOURCE: Congressional Budget Office.

a/ Millions of barrels per day.b/ Dollars per barrel.c/ In billions of dollars.

The Tax on Utilities. The corresponding user tax for utilities would go into effect in 1983 at a flat rate of 25 cents per million BTUs. Based on the assumption that 90 percent of utility oil consumption would be residual fuel and that 1.4 million barrels per day in 1985 would be consumed, the tax revenues are estimated to be approximately \$470 million in that year. (Chapter V explains this tax in detail.)

Increases in Production of Oil

The President's proposals attempt to provide incentives to seek new oil production by allowing the price of newly discovered oil to escalate within three years to 1977 world prices, adjusted for domestic inflation. The plan correctly states

that the revenues per barrel collected by the oil industry would be higher than in any other oil producing countries due primarily to the low production taxes or royalties permitted United States producers. Because domestic costs of production are also high relative to other countries, however, producers still argue that additional incentives are necessary.

CBO believes that the amount of oil produced in response to small price increases seems very limited. The increase in oil and gas prices since 1973 has been several times larger than the increase proposed by the plan, yet increases in production have been modest. It is questionable whether price increases above those proposed in the President's plan would stimulate substantial additional investment in exploration and development. Second, incentives such as decontrol of old oil would not necessarily be an efficient means of stimulating new production as this decontrol would not represent a rate of return on the new exploration and development, but mainly a windfall profit. It could, however, be argued that decontrol would improve the cash flow position of the industry. Most economists agree, however, that investment is influenced most heavily by the price of new oil (discovered after April 20, 1977) rather than by the average prices. Unless an industry cannot attract credit, and the oil industry has few such problems, the price of newly discovered oil would generally be the most important determinant of new investment. The National Energy Plan correctly states that the marginal prices proposed in the plan (\$14.69 per barrel) would yield among the highest revenues per barrel available to the industry anywhere in the world.

In conclusion, it is possible that some huge new discoveries in virgin areas (the Atlantic, the Gulf of Alaska) could change the entire outlook. However, without those discoveries, the increase in production of oil will come from increased development of known but costly fields and advanced recovery from older fields.

This report projects that 200,000 barrels per day additional oil would be produced in 1980 as a result of the President's energy plan. About half of the increase is from advanced recovery, and half is from increased drilling of known but sub-commercial pools or extensions. New discoveries as a result of enactment of the President's proposals could not be developed by 1980.

By 1985, production could be increased substantially but it is virtually impossible to make a prediction of how much at this time. There are few additional incentives that are efficient which can be created by using market mechanisms without explicit subsidies. Although the President's proposals have been criticized because they allegedly provide a few incentives for increased production, in fact, the plan does virtually decontrol prices of new oil and thereby rewards exploration and new production. The effects of the incentives will probably be modest but may be the best that can be expected. No amount of additional incentive is likely to substantially change the situation.

CHAPTER IV. THE NATURAL GAS PROPOSAL

The proposals in the Administration's energy plan related to natural gas are designed to accomplish four objectives:

- o to equalize the costs between interstate and intrastate markets
- o to place the burden of new high-priced discoveries of natural gas on industry, and thus encourage them to convert to the use of coal
- o to eliminate the possibility that producers could collect windfall profits because of new higher prices
- o to protect interstate residential consumers from supply curtailments

The specific proposals within the plan are: to merge interstate and intrastate markets by placing federal controls on intrastate production, thereby limiting intrastate price increases; to pass price increases through to large consumers; to place a user tax on industrial and large commercial consumers; and to restrict the construction of facilities that burn natural gas.

CBO analysis indicates that implementation of these proposals would accomplish the above objectives. Shortages or curtailments to industrial and residential customers would be greatly reduced or avoided, large price anomalies would be reduced and industry and electrical utilities would begin conversion toward use of coal and renewable energy resources. However, it is likely that the most significant impacts of implementation of these proposals would be felt after 1985.

But the plan has, however, been criticized by producers for not adequately stimulating new production. CBO analysis of these proposals does not concur with this criticism. Although prices for new gas are controlled under the plan, the proposed level of the controls (a cap of \$1.75 per thousand cubic feet, at current prices) appears to be high enough to encourage exploration and new production, and it is unlikely that production would be much higher if prices were not controlled. Moreover,

if the prices were not limited, new gas prices could go as high as \$4-\$5 per thousand cubic feet and producers could reap large windfall profits.

PROPOSED POLICY

Currently, natural gas is sold in two distinct markets: The interstate market, where natural gas prices are regulated by the Federal Power Commission (FPC); and the intrastate market, where prices are not controlled. In recent years, the intrastate price has been far above the interstate price allowed by the FPC. Interstate prices regulated at low rates have encouraged gas consumption and discouraged the search for new gas to supply the interstate system. Since 1970, over 90 percent of new reserves have been dedicated to intrastate markets. 1/

A key proposal in the Administration's energy plan is to end the distinction between the two markets by bringing intrastate gas under federal control. The price allowed for new gas in this combined market would be equivalent to the average price of domestic crude oil. This price is expected to be about \$1.75 per thousand cubic feet in 1978. 2/ This price is higher than the price now allowed for new gas in the interstate market (\$1.46 per thousand cubic feet), but lower than many of the prices now paid for new intrastate gas which vary from \$1.50 to \$2.00 per thousand cubic feet. 3/ In addition, the plan would authorize the establishment of higher price levels to provide an incentive for specific categories of high-cost gas.

1/ Federal Energy Administration, National Energy Outlook, February 1976, p. 9.

2/ New gas is defined as gas from a well more than 2.5 miles from an existing onshore well or more than 1,000 feet deeper than any well within the 2.5 mile radius. New offshore gas is defined as gas from lands leased after April 20, 1977. The price for new gas will be limited to the BTU equivalent.

3/ Federal Energy Administration, Monthly Energy Review, March 1977, p. 75.

Under the President's plan, industries and electric utilities will be encouraged to switch from natural gas (and oil) to other fuels. Incentives to convert will be provided by use of incremental pricing and a user tax.

The incremental pricing proposal would require all utilities using or distributing natural gas to pass on all the additional costs of new, usually higher-priced, gas to consumers in industrial, large commercial, and electrical utility sectors. This proposal therefore buffers residential and small commercial users from increased prices, and, instead, places the burden of the higher prices on those consumers (utilities and industry) who are most able to convert to coal. CBO analysis indicates that incremental prices could be as much as three times higher than average prices currently in existence.

Starting in 1979, a user tax would be imposed on all large industrial users of natural gas except fertilizer producers and certain agricultural users. ^{4/} In 1983 a similar tax would be imposed on utilities that consume natural gas. Furthermore, federal regulations would prohibit the use of natural gas in new industrial boilers. Utilities and existing industrial facilities that can burn coal might also be prohibited from using gas in the future.

The President's proposals would also encourage the development of new gas supplies. For example, it would promote "full development" of the Outer Continental Shelf (consistent with environmental safeguards) and would allow additional imports of liquefied natural gas. A federal task force would be established to identify areas where additional synthetic natural gas plants could be built. Finally, research and development programs would be expanded to explore new sources of gas such as Devonian shale.

^{4/} Industrial users would be taxed by an amount equal to the difference between their average gas cost and a target price which is determined by the price of distillate oil. The proposal exempts small industrial users and proposes a graduated scale of taxable use for intermediate users.

TABLE IV-1. PROJECTED NATURAL GAS WELLHEAD PRICES AND QUANTITIES a/
SOLD: IN 1977

		<u>1980</u>		<u>1985</u>	
	<u>1977</u>	Present Policy	Carter Proposal	Present Policy	Carter Proposal
Interstate Gas					
Quantity <u>b/</u>	10.1	9.0	9.4	8.1	9.4
Price <u>c/</u>	78	97	104	141	147
Intrastate Gas					
Quantity <u>b/</u>	9.3	9.7	9.3	10.8	9.5
Price <u>c/</u>	92	149	139	205	166
Total National Average					
Quantity <u>b/</u>	19.4	18.7	18.7	18.9	18.9
Price <u>c/</u>	84.5	124	121	178	156

SOURCE: Congressional Budget Office.

a/ Quantity is net marketed production as defined by the U.S. Bureau of Mines.b/ Per trillion cubic feet.c/ Per thousand cubic feet.

As with the other components of the Carter plan, the proposals concerning natural gas are designed to conserve energy, to provide proper incentives for development of new gas supplies, to encourage conversion to coal, to allocate scarce resources among regions and consumers, and to avoid unnecessary costs to the consumer. The extent to which the proposals would attain these goals is addressed in the remaining parts of this chapter.

ENERGY IMPACTS

With or without implementation of the National Energy Plan, natural gas prices will be higher in the future and slightly less gas might be available. If enacted, however, the plan would make a difference in how high prices would be, what regions would bear the burden of the price increases, and what regions would receive the limited supplies.

The estimated prices charged at the wellhead and quantities of gas available in the interstate and intrastate markets with and without the Carter plan in 1980 and 1985 are shown in Table IV-1. Enactment of the Administration's proposal would mean that, in both years, customers served with interstate gas would find more gas available, but at somewhat higher prices. However, the gas that intrastate consumers received would be less expensive under the plan. ^{5/} For the nation as a whole, natural gas prices will be slightly lower with enactment of the plan.

Effects of the Proposals on Consumers

As shown in Tables IV-2 and IV-3, the President's natural gas proposals will affect various groups of consumers in different ways. This section will discuss the effects of these proposals on the availability of gas and the prices that would be paid by various groups of consumers. The subsequent section will discuss the effect of the proposed user tax on prices for industries and utilities.

Residential and Commercial. Residential and commercial users of natural gas would have slightly more gas available with enactment of the proposals. Furthermore, in both 1980 and 1985 implementation of the President's proposals would significantly reduce average fuel bills paid by residential and

^{5/} It is often misleading to use average prices for the intrastate market. Many industrial customers are served directly by producers so that their rates will increase abruptly as new contracts are negotiated. In the interstate market, customers are usually served by distributors who co-mingle cheap and expensive gas so that prices charged to consumers often reflect average gas prices.

TABLE IV-3. PROJECTED CONSUMER PRICES OF NATURAL GAS BEFORE USER TAXES:
IN CENTS PER THOUSAND CUBIC FEET

	1977	1980		1985	
		Present Policy	Carter Proposal	Present Policy	Carter Proposal
Residential Commercial					
Intrastate	192	249	202	305	222
Interstate	223	242	221	286	242
Industrial					
Intrastate	112	169	161	225	196
Lease and Plant	97	154	146	210	181
Interstate	118	137	170	180	237
Transportation					
Total	105	130	123	165	220
Utility					
Intrastate	112	169	141	225	196
Interstate	123	142	130	185	242

SOURCE: Congressional Budget Office.

TABLE IV-2. PROJECTED CONSUMPTION OF NATURAL GAS IN TRILLIONS OF
CUBIC FEET

	1977	1980		1985	
		Present Policy	Carter Proposal	Present Policy	Carter Proposal
Residential and Commercial					
Intrastate	2.0	2.1	2.2	2.1	2.3
Interstate	<u>5.5</u>	<u>5.7</u>	<u>5.7</u>	<u>5.5</u>	<u>5.9</u>
Total	7.5	7.8	7.9	7.6	8.2
Industrial					
Intrastate	3.6	4.2	4.2	6.0	4.8
Lease and Plant /	1.6	1.1	1.1	0.9	0.9
Interstate	<u>3.3</u>	<u>2.4</u>	<u>2.7</u>	<u>2.1</u>	<u>3.3</u>
Total	8.5	7.7	8.0	9.0	9.0
Transportation					
Total	0.6	0.5	0.5	0.4	0.5
Utilities					
Intrastate	2.0	2.3	1.9	1.8	1.1
Interstate	<u>0.8</u>	<u>0.4</u>	<u>0.4</u>	<u>0.1</u>	<u>0.1</u>
Total	<u>2.8</u>	<u>2.7</u>	<u>2.3</u>	<u>1.9</u>	<u>1.2</u>
Grand Total	19.4	18.7	18.7	18.9	18.9

SOURCE: Congressional Budget Office.

commercial customers compared to what they would pay under continuation of present policy, particularly those served by intrastate sources. The gas prices paid by these groups would, on average, be 22 percent lower. Furthermore, both residential and commercial groups would be protected against curtailment of supply.

It should not be expected, however, that the availability of natural gas will permit many new homes to be serviced by gas.

Industry. In recent years, because of federal and state gas emergency allocation priorities, interstate industrial customers have borne the brunt of gas service curtailments. Because more gas would be available to consumers now served by the interstate systems than would be available under present policy, interstate industrial customers would have more gas available to them with the President's proposals. The additional supplies, however, will be at much higher prices than at present.

If the incremental pricing proposal were enacted, industries using gas would pay significantly higher prices than they would under present policy because the new higher prices would be passed on to them and to utilities and not to residential and commercial customers. The proposed user tax would further increase the price of gas for industry and utilities.

Industries served by interstate pipelines would receive less gas in 1980 under the Carter proposals than they do now, but as a result of general conservation measures in other sectors, gas supplies to industrial customers could increase after 1980. In the long run, the supply position of industries using interstate gas would be much better with implementation of the plan. Intrastate industry would have more gas available in 1980 and 1985 than it has in 1977, but less in 1980 and 1985 than it would have under present policy.

Electric Utilities. The proposed user tax on utilities burning gas is intended to encourage a significant number of utilities to convert from gas (and oil) to coal. However, if this user tax were implemented, it would not go into effect until 1983. Thus any significant conversions by utilities would not take place until after 1983. At present the prices

paid by utilities using intrastate gas are actually substantially lower than the prices they would have to pay for alternative fuels. By 1985, however, electric utilities would be using about 37 percent less gas with the plan.

The Effect of the User Tax on Natural Gas Prices

If the President's plan were enacted, a user tax for industrial consumers of natural gas would go into effect in 1979. In 1979, the tax would be the difference between the specific price charged the industrial consumer, and a target level which would be set at about \$1.05 per thousand cubic feet below that of competing liquid fuels (distillate fuel oil would sell for the equivalent of about \$3.05 per thousand cubic feet). The target level would escalate each year until 1985 when it would equal the price of distillate. The expected prices and tax revenues for industrial users (gas use in transportation is not included) are summarized in Table IV-4.

By 1980, the price of distillates is expected to be equivalent to about \$3.09 per thousand cubic feet, and the target price would be \$2.69 per thousand cubic feet. Industrial prices should range from a low of about \$1.46 per thousand cubic feet for field use of intrastate gas to about \$1.70 per thousand cubic feet for average interstate gas. The tax (the difference between the specific price and \$2.69 per thousand cubic feet) would therefore apply to virtually all marketed gas in 1980 except for that proportion exempted for small consumers. Total revenue to the treasury is expected to be about \$6.1 billion in 1980 (in 1977 dollars).

In 1985, the price of distillates is expected to be about \$3.32 per million BTU, and the target price in that year equals the distillate price. Virtually all industrial gas would be sold at delivered prices below the target and would therefore be subject to the user taxes. Revenue in 1985 would be approximately \$8.0 billion.

In summary, natural gas prices paid by industrial users would more than double from 1977 to 1980. Of the increase in prices, about one third would be due to increased prices in the field--much of which would occur even without implementation of the President's plan. The remainder of the increase is due to the user tax. Prices would increase another 23 percent in real terms by 1985. Furthermore, despite differences in wellhead prices for intra and interstate gas, all classes of industrial users would be paying identical gas prices under the President's plan.

TABLE IV-4. PROJECTED INDUSTRIAL PRICES AND TAX REVENUES

	Quantity Subject to Tax <u>a/</u>	Average Price Before Tax <u>b/</u>	Average Price After Tax <u>b/</u>	Average Tax <u>b/</u>	Revenue (In billions of dollars)
<u>For 1980</u>					
Intrastate	2.8 <u>c/</u>	161	269	108	3.0
Lease & Plant	0.6 <u>c/</u>	146	269	123	0.7
Interstate	2.4 <u>c/</u>	170	269	99	<u>2.4</u>
Total Revenue					\$6.1
<u>For 1985</u>					
Intrastate	3.2 <u>c/</u>	196	332	136	4.4
Lease & Plant	.5 <u>c/</u>	181	332	151	0.8
Interstate	3.0 <u>c/</u>	237	332	95	<u>2.8</u>
Total Revenue					\$8.0

a/ In trillion cubic feet.b/ In cents per thousand cubic feet.

c/ An estimated 25 percent of intrastate gas would be exempt from user taxes (petrochemical and fertilizer feedstocks, agriculture uses, or field use) and about 50 percent of lease and plant uses would be exempt. Furthermore, about 10 percent of intrastate and interstate consumption would not be "taxable use" as defined in Sec. 4992 of the proposed National Energy Act.

As stated earlier a similar user tax is proposed for electrical utilities, beginning in the year 1983. By the year 1985, utilities would pay a tax based on the difference between the price of distillates, less \$.50 per thousand cubic feet, and the specific price of gas paid by the utility. On average, interstate utilities should expect prices averaging about \$2.42 per thousand cubic feet in 1985, and intrastate utilities should expect prices of about \$1.96 per thousand cubic feet. As a result, interstate utilities will be taxed about \$.40 per thousand cubic feet on the average. The tax for intrastate utilities would be about \$.86 per thousand cubic feet. Because some specific interstate utilities might have contracts in excess of the target, only 90 percent are estimated to pay taxes. Virtually all intrastate utilities would pay taxes. Total tax revenues are estimated to be about \$1.0 billion in 1985.

Increases in Production

Prices received by the majority of onshore producers of new gas are presently between \$1.50 per thousand cubic feet and \$2.05 per thousand cubic feet (the price of new intrastate contracts). ^{4/} Offshore producers would pay a price of \$1.46 per thousand cubic feet because Outer Continental Shelf (OCS) gas can only be sold in interstate markets. The President's plan would combine the markets and limit the price to \$1.75 per thousand cubic feet in 1977. This price would escalate in real terms, depending on the price of domestic crude oil. Under present policy, average new intrastate prices, are projected to escalate to about \$2.55 per thousand cubic feet by 1985; under the President's plan, the equivalent new gas price would be about \$2.08 per thousand cubic feet.

CBO's analysis concludes that exploration and development of new reserves would be stimulated by increased prices, but that the difference in impact between the prices both under present policy and under the President's proposals would be very small--certainly not enough to elicit a measureable difference in production by 1980. By 1985, however, the increase in interstate prices should stimulate slightly more production from the OCS than would occur under present policy. This increase will probably compensate for the projected decrease in new intrastate gas production.

The President's Plan forecasts that under a continuation of present policies, intrastate prices for new gas would plateau or even decline because of an expected increase in gas supplies as a result of recent price increases. This forecast is controversial. Some assert (primarily industry experts) that producible reserves are lower than recent federal estimates and that the amount of new production will be disappointing. They believe, therefore, that intrastate new contract prices will continue to rise toward the price of alternative fuels (about \$2.80 per thousand cubic feet).

^{4/} "Summary of Intrastate Natural Gas Prices," Federal Power Commission, as reported in Monthly Energy Review, Federal Energy Administration, March 1977, p. 75.

If prices were to level off, or recede somewhat, the price cap in the President's plan would pose no constraint to prices and the free-market price would float somewhere below the cap. The purpose of the cap would be to avoid producers charging prices which distributors could "roll-in" with their older supplies. The projections in this analysis, however, indicate that the proposed cap is below the potential market price, but probably not to an extent to affect exploration or production to a significant degree when combined with a projected increase in OCS production.

Finally, it is noted that some pricing provisions of the plan seem inconsistent with the aim of achieving high levels of gas production without providing windfalls to the producers. For example, there seems to be no justification for allowing expiring contracts for interstate gas to be renewed at prices as high as \$1.42 per thousand cubic feet. This would appear to be an invitation to windfall profits for some producers.

CHAPTER V.

COAL CONVERSION

Several of the proposals in the National Energy Plan involve encouraging or requiring the substitution of coal for oil and natural gas in industrial and public utility use. In fact, more than half of the anticipated savings in imported oil by 1985, projected in the President's plan, would be the result of coal conversion.

Although, CBO is in general agreement with the President's estimates of public utility uses, it is skeptical that the amount of industrial conversion envisioned by the Administration will be forthcoming by 1985. The President's plan anticipates an increase in the industrial consumption of coal from 156 million tons in 1977 to 410 million tons in 1985. Most of the increase would take place in non-metallurgical coal which would have to increase from 70 million tons in 1977 to 305 million tons in 1985. The Administration estimates that the attainment of this goal would require that 10 percent of all existing industrial facilities burning oil or gas and 44 percent of newly constructed industrial facilities would have to convert to coal. This contrasts with the continuation of current policy where only 12 percent of new industrial facilities would burn coal in 1985.

CBO agrees with the Administration's estimate of a 10 percent conversion of existing industrial facilities, but projects only a 33 percent increase in new industrial uses with implementation of the President's proposals. A 33 percent increase would result in total coal consumption by industry of 360 million tons by 1985—50 million tons short of the Administration's projections. In terms of barrels of crude oil equivalents, CBO conversion estimates translate into oil import savings of 1.8 million barrels per day which is 0.6 million barrels below the President's estimate.

The lower estimate of industrial coal conversion provided by CBO is based on the difficulties of altering existing planned construction, the problems that may arise with transporting coal to the factory, environmental restrictions and the desire of industry to take full advantage of the rebate system by stretching out new construction.

It is possible, however, that the additional 50 million tons of coal production estimated by the Administration could be achieved if more stringent regulations regarding future burning of oil and gas were imposed by the Administration, or if the above problems prove easier to solve.

PROPOSED POLICIES

The immediate goal of the President's proposed coal program is to increase the production of coal, presently at about 680 million tons per year, by 400 million tons per year by 1985. This increase is to be encouraged primarily through the use of price incentives and regulation, implemented without adverse effects in the environment.

A second goal is to provide efficient, economically feasible technologies for the longer term that will support the substitution of coal for oil and gas.

Two types of taxes have been proposed to further the incentive to conversion to coal. The first, designed to increase the price of domestic oil, has been discussed in detail in Chapter III of this paper. The second, a users tax plus rebates is designed specifically to encourage the use of coal in new and existing facilities.

If this users tax is implemented, industrial users of oil would be taxed beginning in 1979 at about \$0.90 per barrel. This tax would increase to about \$3.00 per barrel by 1985. Industrial users of natural gas would also be taxed. This tax would be imposed in 1979 and would be the difference between the average price of natural gas and a target price that would be set in 1979 at about \$1.05 per thousand cubic feet below the price of other liquid fuels--such as distillate oil. The target price would increase incrementally each year until 1985. At that time, the price of natural gas would equal that of distillate.

Public utilities would also be taxed under the President's plan but the tax on utilities would not be implemented until 1983. At that time, an additional tax of about \$1.50 per barrel would be applied to all oil burned by utilities.

Utilities burning natural gas would pay a tax based on the difference between their cost of gas and the equivalent BTU price of distillate. This tax would also begin in 1983 and would be imposed in the same fashion as the tax on industrial users of gas except that the target price would be set at about \$0.50 per thousand cubic feet below the price of distillate oil.

Since it is less feasible for economic reasons for small industrial users to convert to coal, users consuming less than 500 billion BTUs per year--about 90,000 barrels of oil per year--would not be required to pay tax.

A major component of the proposed user tax is the existence of tax rebates to industries that convert to coal. An industrial user would have the option of either using an additional 10 percent investment tax credit or taking a rebate of up to that year's oil or gas tax and investing the rebate in coal conversion. Utilities would have the option of receiving a rebate on the user tax paid to be used for new construction which would help accelerate the retirement of facilities burning gas or oil.

President Carter's coal conversion program also includes restrictions on the burning of natural gas:

- o With only limited exception, no new boilers would be constructed that burned either oil or natural gas.
- o Other industrial facilities could be prohibited from burning natural gas.
- o Existing boilers capable of burning coal could be prohibited from burning oil or natural gas.
- o Utility boilers would be prohibited from burning gas after 1990, with certain limited exceptions.
- o Any industrial facilities burning coal would need permits to shift to oil or gas, and utilities would need permits to shift from gas to oil.

An integral part of any coal conversion program is a policy regarding the effects of conversion on the environment. The President's plan would require that the best available technology be applied to clean up all coal burning plants. At present, this requirement would make scrubbers (flue gas desulfurization)

mandatory in all large coal-fired facilities whether or not low sulfur coal is used, thus reducing the pressure to use low sulfur western coal.

Although not a part of the present energy plan before the Congress, proposals to fund expanded research and development (R and D) in the area of coal technology will eventually become part of an overall energy policy. New R and D initiatives would probably include accelerated research on ways to clean coal before it is burned and to clean the smoke from coal burning; plus demonstrations of new ways to process and burn coal (e.g., fluidized bed combustion and low BTU coal gasification). These efforts would not include subsidies for existing BTU gasification technologies.

ENERGY IMPACTS

Unless converted to liquid or gaseous form, coal is inconvenient to use except as fuel for relatively large, stationary boilers. Consequently, the market for coal is likely to be greatest for the electric utilities and large industrial consumers that have such boilers. Demand for coal is sensitive to its price and availability and to that of alternative fuels. Air pollution regulations, and the cost of coal-fired facilities and related coal handling equipment also affect its use.

In 1976, U.S. coal production was 681 million tons, which included 459 million tons for electric utilities, 6 million tons for household and commercial consumers, 156 million tons for industrial users, and 60 million tons for export. Total domestic coal consumption was 621 million tons.

Different assumptions about factors affecting coal demand can give rise to very different projections of coal consumption in 1985. Various estimates project that under present policy, domestic coal consumption in 1985 could be as low as 730 million tons, or as high as 1,305 million tons.

The projections of present policy assume that oil price controls will be continued, interstate natural gas will be regulated at \$1.42 per thousand cubic feet by the Federal Power Commission, air pollution standards will require either scrubbers or low sulphur coal, coal conversions required under present law are carried out, world oil prices are constant in real dollars, and real coal prices rise at about 2 percent per year.

The projections for the President's coal conversion proposals assume that the wellhead taxes on crude oil and industrial and utility user taxes will be implemented, the rebates will be available, and regulatory restrictions on burning oil and gas will be implemented. The major variables affecting coal demand that are not components of any of the above assumptions are: the relative capital cost of coal and the use of nuclear power by utilities. Consequently, considerable uncertainty about coal demand remains.

Utility Coal Consumption

For the present policy projections, coal demand by electric utilities has been estimated to increase to about 768 million tons by 1985, resulting in an annual rate of increase of 5.9 percent.

Under the President's proposals utility demand for coal has been estimated to increase to about 777 million tons by 1985 which is in general agreement with present policy projections.

Electric utilities will find coal superior to oil and gas as fuel for new base-load facilities given almost any set of energy prices. 1/ The level of coal demand for new baseload facilities will depend on total electricity demand and on the coal-nuclear mix. Under present policy, construction of new coal-fired power plants to substitute for existing oil-fueled base-load facilities will probably also be economically attractive to utilities.

However, substitution of coal for oil in intermediate-load facilities is less likely to be attractive until oil price controls are removed and domestic oil prices rise. The price of utility fuel would have to go substantially above current world coal prices before it would become attractive to construct new coal-fired facilities to substitute for existing oil-fired plants in intermediate load service. 2/

There are various reasons why implementation of the President's coal conversion program would result in only a small

1/ Council on Wage and Price Stability Staff Report, A Study of Coal Prices, March 1976, pp. 52-53.

2/ Federal Energy Administration, 1976 National Energy Outlook, p. 182.

increase in the use of coal in utilities by 1985. In brief, these reasons relate to proposed requirements for protecting the environment, and long lead times associated with building new facilities.

- o Environmental Restrictions. The proposed environmental standards for coal use would require the best available pollution control technology for all new facilities (including those burning low sulfur coal), thus increasing the capital cost of coal-fired plants. Consequently, because of these restrictions, a slightly larger number of utilities would turn to nuclear power than is anticipated under present policy. However, this factor will not be of any great significance until after 1985.
- o Long Lead Times. Over the past few years, construction of a significant number of coal-fired power plants has already begun, many of which are scheduled to begin operation in 1978-1981. ^{3/} However, it is not likely that these plants will be affected by the President's proposals. Any concentrated effort to construct new coal-fired plants, resulting from the coal conversion program, will mean that these plants will not become operational until well after 1985, because of the long lead time needed to construct the facilities. However, conversion of existing facilities, when technically feasible, may occur more quickly.

Industrial Coal Consumption

The key to the President's coal conversion program is the conversion of industrial facilities from oil and gas to coal. The success of industrial conversion will account for nearly all of the difference between present policy projections of coal consumption and projections of the President's proposals. Indus-

^{3/} R. L. Gordon, The Future of Western Coal, Chapter 5; and Marketing Prospects for Western Coal, a report to the National Science Foundation, Grant Number OEP-75-20827, December 1976, Chapter 5, pp. 31-34.

trial consumption of metallurgical coal will increase somewhat, but will be the same in 1985 whether the coal conversion program is enacted or not.

Fossil fuels are presently used in industrial settings in four ways:

- o to generate steam
- o to generate electric power
- o as a source of direct heat
- o as feedstocks

The major growth in demand for coal will be for those uses, exclusive of feedstocks, which in 1968 resulted in 89 percent of all industrial fossil fuel consumption. 4/

The economics of coal transportation and combustion technology make the costs of burning coal much higher for smaller installations than for larger ones. Therefore, it is not feasible to anticipate that all industrial facilities could convert to coal to generate steam and electric power in the foreseeable future. Furthermore, small installations may find meeting air quality standards more difficult if they convert to coal. 5/ There will be further difficulties in converting to coal as a source of direct heat because of elements in the coal--such as sulfur--that may contaminate the product being heated.

Projections of present policy indicate that industrial demand for non-metallurgical coal will increase by 4 percent a year reaching about 100 million tons by 1985. Combining all industrial uses for coal will create a demand for about 206 million tons in 1985, under present policy.

4/ R. L. Gordon, Historical Trends in Coal Utilization and Supply, August 1976, prepared for U.S. Bureau of Mines, Chapter 7, pp. 3-5.

5/ If new technology, such as the fluidized bed combustion passes the demonstration stage soon, industry may be able to use more coal in small installations.

President Carter's energy proposals for coal conversion combine economic incentives with user taxes and regulatory restrictions to convince various energy sectors to convert both new and existing facilities to the use of coal. However, projections of energy use in industry indicate that even if gas were taxed at a rate higher than that proposed by the President, most industrial facilities would still substitute gas for coal if the gas were available. Consequently, oil and gas taxes and conversion incentives by themselves may be ineffective in discouraging the use of gas as a primary energy source in industry.

On the other hand, direct regulatory restrictions on gas use, also proposed by the President, would transfer the demand for gas to oil or coal.

The Administration estimates that the President's proposals would result in the conversion of about 10 percent of existing industrial facilities from oil and gas to coal plus the substitution of coal for oil and gas in about 44 percent of new facilities by 1985.

This conversion and substitution is estimated by the Administration to result in industrial non-metallurgical coal consumption of nearly 305 million tons by 1985, a growth rate of 16 percent per year. This is an increase of 200 million tons over estimated demand under present policy. About 50 million tons of the increase is due to conversion of existing facilities and about 150 million tons would result from the substitution of coal for oil and gas in new facilities.

CBO analysis concurs with Administration estimates of a conversion to coal by 10 percent of existing facilities by 1985. However, CBO estimates conclude that 33 percent of new facilities would substitute coal for oil and gas by 1985 instead of the 44 percent estimated by the Administration, if the President's proposals were implemented. Various problems exist which CBO believes may affect the Administration estimates. These include the exemption of user taxes on small facilities, facilities already planned or under construction which may not be able to convert to coal, difficulty in meeting environmental standards, difficulties in transporting coal to newly constructed facilities, and the stretching out of construction of new facilities beyond 1985 to gain optimal benefits from tax incentives. However, it is possible that a strong regulatory program which simply prohibited most non-coal facilities and strong government efforts to solve the aforementioned problems could increase coal production closer to the Administration estimates.

CBO estimates that if the President's coal conversion proposals were implemented, non-metallurgical industrial coal consumption in 1985 would be about 150 million tons more than consumption estimated under present policy, resulting in a growth rate of about 14 percent. Although CBO estimates indicate 50 million tons less in industrial coal consumption by 1985 than the Administration estimates, it is likely that if these estimates were projected to 1990, CBO and the Administration estimates would differ only slightly.

The export of coal would, on the whole, not be affected by the President's proposals. Thus, estimates of exports under present policy and with implementation of the President's proposals do not differ. The projections suggest an increase in the amount of coal exported from about 60 million tons in 1976 to 90 million tons by 1985. Estimated coal consumption for various sectors, both under present policy and under CBO estimates of the President's proposal, is shown in Table V-1.

TABLE V-1. COAL CONSUMPTION (MILLION OF TONS)

Coal Consumers	Current Policy		Carter Policy
	1976	1985	1985
1) Electric Utilities	459	768	777
2) Household/Commercial	6	2	2
3) Industrial	156	206	360
4) Exports	60	90	90
Total	681	1,066	1,229

SOURCE: National Energy Plan and Congressional Budget Office.

SUPPLY OF COAL

The success of conversion from gas and oil to coal is more likely to be constrained by inadequate demand than by inadequate supply.

U.S. coal reserves are concentrated in the Appalachians, the Midwest, and the Northern Great Plains. Most Appalachian and midwestern coal has higher heating value and higher sulfur content than does Great Plains coal. Appalachian and midwestern coal is also more expensive to mine, because it is found in thinner, deeper seams than the Great Plains coal which can be easily strip-mined. However, Great Plains coal is located further from major electricity markets, and thus, carries higher transportation charges. Great Plains coal reserves are also sufficiently large and of such even quality that production can be expanded without increasing unit costs. Costs of producing coal in other regions are likely to rise as it becomes necessary to utilize less accessible and lower-quality reserves. The amount of western coal that finds its way to eastern markets will depend on relative production costs in the different regions, transportation costs, and on the premium users are willing to pay for low-sulfur coal.

Financing for coal mine expansion has been cited by some authorities as a potential constraint to increasing coal production. However, financing is readily available to any mining concern with long-standing contracts with its customers. These contracts can be used as collateral to provide financing for new operations. If the demand for coal continues to increase, the desire for contracts by coal users will also increase, ^{6/} as will the collateral.

If conversion to the use of coal is undertaken to the extent estimated in the President's proposals, coal production could fall short in the short term. And the mismatch of short-term demand and supply could cause sharp coal price increases which could, in turn, create decreases in future coal demand. The phasing in of user taxes as proposed may greatly mitigate such effects.

^{6/} Mitre Corporation, Report on Potential Constraints to Coal Supply, January 1975.

In all of these projections of the increase in coal supply one very large uncertainty remains. The effect of an increase in coal production in the West from about 100 million tons now to near 400 million tons in 1985 will require a great effort to mitigate adverse effects on the environment, transportation systems, and the life of western communities. To the extent that these issues cannot be easily solved, coal prices may rise and production may be reduced. Since utility consumption has to be contracted in advance, it is likely that any net reduction of western production that may occur will reduce the conversion of industries which are more dependent on shorter-term commitments. Of course if this results in simply a shift to eastern coal, industry may still have adequate coal, at somewhat higher prices.

OTHER IMPACTS

Consequence of Environmental Restrictions

The most significant problems associated with future coal use relate to the adverse effects on the environment of coal production and use.

Strip-mining of coal is a very visible example of the deleterious effects to the environment of coal production. Strip-mining necessitates excavating very large land areas. This land must be completely restored and revegetated in order to be used for other purposes. There is some question about the feasibility of restoring strip-mined land in the Great Plains coal fields; eastern strip mines can be restored, but at a cost that could be as high as \$4.85 per ton of coal mined. ^{7/} Mining can also adversely affect water supply and quality. More sulfur oxides and particulates are emitted into the atmosphere by typical coal-burning installations than would be emitted by similar facilities burning oil or gas. Measures that would mitigate these effects are available, at a cost.

The stringent application of environmental regulations, coupled with the desire to increase dramatically the use of coal in all energy sectors, creates a paradox. Furthermore, should environmental goals become even more ambitious, it is possible that expanded use of coal will become relatively less desirable.

^{7/} Council on Environmental Quality estimates cited in Council on Wage and Price Stability, Study of Coal Prices, p. 79.

This could be true particularly for use of coal by small industrial facilities, or in facilities that do not have a long history of pollution control.

However, for the time being it is likely that coal use and production will respond to government incentives whether stringent or lenient environmental regulations are chosen. But stringent standards and rapid development may be consistent only if substantial expenditures to compensate for higher coal costs or penalties on the use of other fuels are imposed.

BUDGET IMPACTS

If the President's coal conversion proposals were implemented, user taxes on industrial and utility oil and gas consumption would be phased in over a five-year period. Industrial users of oil and gas converting to coal would be eligible for a rebate of these taxes paid in any given year, not to exceed investment expenditures on "alternative energy property"--i.e., property that qualifies for the rebate plan--in the same year. Qualified expenditures in excess of the firm's user tax each year could be carried forward and claimed as a rebate of a future year's user taxes. Industrial firms would have the option of electing--on a once and for all basis--an additional 10 percent investment tax credit instead of the rebate plan.

The user tax itself increases the incentive to use coal by raising the cost of oil and gas relative to coal. The rebate reduces the capital cost of acquiring coal-burning equipment; together the two give a strong incentive to use coal rather than oil or gas.

The user tax is a business expense deductible from sales revenues in computing taxable income. CBO estimates assume that the businesses will pass the user tax through to their customers in higher sales prices, thus increasing sales revenues by the amount of the tax. Under this assumption the user tax will not change businesses' income tax liability. ^{8/} Every \$1.00 of

^{8/} On the other hand, to the extent that a dollar of user tax is not "passed through," then, as corporation income is taxed at the 48 percent corporate rate, every dollar of user tax paid will reduce corporate income tax liability by \$0.48. The net tax bill to the corporation will be \$0.52 and thus total federal tax revenues will increase by only \$0.52.

eligible investment can earn a rebate of \$1.00 of user tax. But in electing the rebate the firm loses its income tax deduction for that amount of user tax. The net result then is to provide the firm with a taxable cash grant of \$1.00 or \$0.52 after tax at the 48 percent corporate tax rate. Therefore, as compared to the option of an additional 10 percent investment tax credit, firms often will be better off paying the user tax and obtaining a rebate. As a result, there will be an incentive to delay conversion of part of a firm's oil- and gas-burning facilities, so that the firm can obtain the largest possible rebate.

User taxes would also be collected from electric utilities. The rebate mechanism is available for utilities but the additional investment tax credit option is not. The definition of qualifying investment is broader for utilities than for other enterprises.

CBO estimates that user tax liability for industries that have not converted to coal would be about \$8.2 billion in 1980 rising to \$12.2 billion in 1985. The total tax liability for these industries during the period 1979-1985 would amount to \$64 billion in 1977 dollars.

The rebate would substantially reduce this tax liability. The cost of constructing a new asset is large compared to the amount of tax a firm will pay for using oil and gas. Therefore, investments that account for even a small proportion of existing capacity can absorb a large proportion of the excise tax. For example, CBO estimates that the cost of converting to or using new coal facilities would be in the neighborhood of \$7.5 billion for each quad of energy. The tax on a quad of gas used in 1985 would be about \$1.2 billion and the tax on a quad of oil would be about \$0.5 billion. CBO estimates that the President's proposals would result in conversion of 10 percent of existing oil and gas uses and the substitution of 33 percent of all new fossil fuel uses for coal, thus rebating between 1970 and 1985 \$38 billion and reducing tax revenues to \$26 billion over the period.

Utility tax liability would be considerably smaller. It would only begin in 1983 amounting to about \$1.5 billion each year. Because of the requirement to retire all gas-fueled generators by 1990, it is quite likely that all of this tax will be rebated to defray costs of retirement.

CHAPTER VI. AUTOMOBILE-RELATED PROPOSALS

The automobile-related provisions of the President's energy proposals are aimed at reducing gasoline consumption 10 percent below current levels by 1985. The plan is to:

- o encourage the manufacture and purchase of cars that are more fuel-efficient through a system of taxes and rebates that would make more efficient cars cheaper and less efficient cars more expensive for the buyer;
- o encourage people to drive fewer miles by imposing taxes that would raise the price of gasoline.

CBO analysis indicates that the President's proposals--combined with fuel-efficiency regulations already on the books--would indeed cut automotive gasoline consumption but probably by no more than 5 percent below current levels by 1985.

The goal of 10 percent reduction in gasoline consumption by 1985 is ambitious, considering that motor gasoline consumption increased an average of 4.5 percent per year between 1965 and 1975. Legislation already on the books, however, as well as the delayed effects of post-embargo gasoline price increases, will slow future increases in gasoline consumption even if no further steps are taken. This slowing will take place as auto manufacturers adjust to higher fuel prices and to existing energy legislation by producing cars with improved fuel economy. It will become evident in national gasoline consumption when, during the next decade, these new fuel-efficient vehicles are phased in and the nation's auto fleet as a whole reflects substantially upgraded fuel economy.

CBO projections presented later in this chapter indicate that, because of improvements in auto fuel economy anticipated under present policy, the gasoline cost per mile of driving a new car in 1985 will be 18 percent lower than it is now. Because of reduced fuel costs per mile and increased affluence, the number of vehicle miles of travel per household in 1985 is projected to be over 20 percent higher than it is now.

There has been considerable public concern about the adjustments in travel which the American people will be forced to make in response to the President's plan. By and large, these adjustments are really slowdowns in the rate of the rise of the standards of living between now and 1985. But even with the rate slowed, the standard in 1985 would still be higher than it is now. For example, the average American family now drives slightly less than 15,000 miles per year. Under the plan, they would likely drive 17,000 miles in 1985, which is more than they drive now even though it is less than the 18,000 miles they would drive without the plan. Similarly, the cost per mile of fueling cars will be lower in 1985 under the President's plan than it is presently, although it would still be lower in 1985 under a continuation of present policy.

Three programs in the President's proposals are likely to reduce future automotive gasoline consumption. The "gas-guzzler" excise taxes and rebates for new cars appear to offer the greatest fuel savings. CBO estimates fuel savings for the gas-guzzler program to be 215,000 barrels a day in 1985 and 450,000 barrels a day in 1990, savings slightly above those projected by the Administration for this program. The crude oil equalization tax would have only minor effects on gasoline consumption, reducing it by about 40,000 barrels a day in 1980, 25,000 barrels a day in 1985, and even less thereafter. The standby gasoline tax could eventually lead to significant fuel savings, but CBO expects only moderate effects by 1985. The stringent gasoline consumption goals contained in the President's plan are projected to trigger the standby gasoline tax from 1982 on, producing additional fuel savings of 65,000 barrels per day in 1985, and 200,000 barrels per day in 1990. Taken together, CBO estimates these three program elements lead to total gasoline savings, relative to present policy, of 305,000 barrels per day in 1985, and 650,000 barrels per day in 1990.

The greater the fuel savings from other measures, the later the standby gasoline tax will be triggered, and consequently, the smaller the savings attributable to the standby tax by 1985. Both the extent of diesel usage within the auto and truck fleets and the stringency of fuel-economy standards to be set for light trucks under the EPCA will play major roles in determining when the standby tax is initially triggered. More diesel usage and more stringent light-duty truck standards could delay triggering

of the standby gasoline tax from 1982 (as projected by CBO) until 1984. On the other hand slower developments in these highly uncertain areas could lead to 1985 motor gasoline consumption that exceeds the Administration target by anywhere from 400,000 to 740,000 barrels per day. The Administration projects 1985 gasoline consumption of 350,000 barrels a day above target without consideration of the standby gasoline tax. Given the magnitude of the differences between the likely outcome and the target projected by both the Administration and CBO, 1985 gasoline consumption is not likely to be held beneath the target that will trigger that standby gasoline tax.

In short, President Carter's program produces sizable gasoline savings--equivalent to about 20 days of auto gasoline use in 1985 and 45 days in 1990. The provisions contained in these proposals do not appear to be sufficient, however, to meet his goal for 1985 gasoline consumption. CBO expects 1985 automobile gasoline consumption under the President's program to be only about 5 percent beneath that experienced in 1976, compared with the 10 percent reduction called for by the President.

Trucks hold the key to narrowing the gap between actual and target gasoline consumption in 1985. There is now one truck for every four cars registered in this country, and the number of light-duty trucks continues to soar as vans, pick-ups, and recreational vehicles increase in popularity. Because of the great variety of trucking equipment and operations, federal programs for trucks can be cumbersome, particularly for heavy trucks, and current truck fuel-economy programs lag behind those for automobiles. As yet to be specified fuel-economy standards for light-duty trucks, authorized by the Congress under the Energy Policy and Conservation Act, will play a key role in shaping an effective and even-handed policy for transportation fuel conservation.

PROPOSED POLICIES

Three of President Carter's energy proposals could have particularly strong impacts on automobile sales, ownership, use, and fuel consumption:

- o Crude oil provisions (price controls and equalization taxes) that would effectively bring domestic crude oil prices up to the world price by 1980 and that would increase them at the rate of inflation thereafter.

- o Graduated gas-guzzler excise taxes and rebates imposed on new cars on the basis of their fuel economy. Similar taxes and rebates would be imposed on light trucks.
- o A standby gasoline tax of up to 50 cents per gallon, imposed in five-cent increments starting in 1979, if actual gasoline consumption exceeds a predetermined target level for each year.

This chapter explores the likely automobile-related consequences of these proposals. 1/ Before examining the effects of the Administration program, each of these auto-related proposals will be summarized and major areas of uncertainty specified.

Crude Oil Equalization Taxes

As noted above, the President's proposal includes measures that would levy a tax on domestic crude oil to bring its net price up to the prevailing world price by 1980. This would in turn increase the price of gasoline at the pump in future years.

Gas-Guzzler Excise Taxes and Rebates

The so-called gas-guzzler provisions of the President's program are excise taxes and rebates for auto manufacturers 2/

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- 1/ The term "automobile" in this report refers to conventional passenger cars and does not include light-duty trucks as does the same term in the Administration's proposed energy bill.
 - 2/ The proposed act would require manufacturers to validate that the rebates and taxes had been passed along to vehicle purchasers. Inclusion of the tax or rebate as a separate item in computing the sticker price would apparently constitute such validation. The act would not prohibit manufacturers from raising the price of vehicles nor from passing along the costs of technological changes made in order to improve fuel economy.

based upon the fuel-economy ratings of new cars that they sell. The objective of this proposal is to provide an additional incentive to automobile manufacturers to improve the fuel economy of their cars and to encourage consumers to purchase vehicles that are fuel-efficient.

The Energy Policy and Conservation Act of 1975 (EPCA, P.L. 94-163) established a set of gradually more stringent new car fuel-economy standards to be implemented between 1978 and 1985. An auto manufacturer who does not meet these standards is liable for civil penalties based upon the degree to which the average fuel economy on its cars falls short of the standards. On the basis of CBO's analysis, it does not appear that the standards and noncompliance penalties built into current law are sufficiently strong to induce full compliance in all future years. Indeed, the analysis presented later in this chapter indicates that, in the absence of further policy changes relative to auto fuel economy and gasoline prices, EPCA standards will yield an average new car fuel economy of only 23.3 miles per gallon (mpg) in model year 1985, well short of the statutory standard of 27.5 mpg.

The gas-guzzler element of the Administration's program is designed to reinforce the existing standards. As stated earlier, the President's proposal calls for imposition of a set of graduated excise taxes and rebates based upon the relative fuel consumption of new vehicles. As proposed, taxes (in current dollars) would range from \$449 for a 12-mpg car to a rebate of up to \$473 for a 38-mpg car in model year 1978. In 1985, the corresponding figures would be a tax of \$2,488 for a 12-mpg car and a rebate of up to \$493 for a 39-mpg car.

In each future year, the proposed tax/rebate schedule uses the current EPCA miles per gallon standards as the dividing line between those cars subject to taxes and those eligible for rebates (for example, 18 mpg for 1978 and 27.5 mpg for 1985).

The magnitude of taxes and rebates increases throughout the 1978-1985 period; but in any single year the differences between tax and rebate entries are roughly proportional to the fuel savings implicit in each extra mile per gallon. For example, if cars are assumed to travel 10,000 miles per year, then improving a car's fuel economy from 12 to 13 miles per gallon saves 64

gallons of fuel per year. Similarly, a simple computation shows that improving a car's fuel economy from 35 mpg to 36 mpg yields fuel savings of 8 gallons per year. Thus, the extra fuel savings associated with one mpg improvement to the 12 mpg car are about eight times those of a one mpg improvement to the 35 mpg car. The Administration tax/rebate schedule reflects these fuel savings by including large steps in the schedule for fuel-economy improvement at the low-mpg end of the table, and small rebate differences for improvements toward the high-mpg end.

Under this proposal, the rebate side of the table would not be specified for future years, however, but would be adjusted from year to year so that rebate payments just balance tax collections. That is, the net tax collections under the gas-guzzler proposal would be zero.

One major area of uncertainty in this proposal is the treatment of imported cars. Since imports are generally smaller and more fuel efficient than domestic cars, the rebates for them would be substantially larger than for the average domestic car if they are treated on the same basis as domestic cars. Thus, equal treatment of foreign and domestic cars could be viewed as a substantial subsidy for foreign automobile production, while omission of foreign cars from the rebate system could be viewed as a trade barrier with effects similar to a tariff.

The actual rebates for imported cars will be determined through negotiations with individual countries to "develop equitable rebate agreements." ^{3/} The Administration's proposed legislation is no more specific, declaring that the agreements with foreign countries "...shall be designed to assure that manufacturers of domestically manufactured automobiles are not disadvantaged...." ^{4/} At this writing, the exact mechanism of achieving this goal is yet to be specified.

Another major uncertainty involves the treatment of light trucks. Under the Energy Policy and Conservation Act, the Secretary of Transportation is authorized to promulgate efficiency

^{3/} Executive Office of the President, Office of Energy Policy and Planning, The National Energy Plan, 1977, p. 38.

^{4/} The National Energy Act, H.R. 6831, Title II, Part B, Section 1202a.

standards for trucks with gross vehicle weight ratings of up to 10,000 pounds. Standards for vehicles under 6,000 pounds (gross vehicle weight) are currently being promulgated, and the President has directed that the Secretary of Transportation begin to set standards on vehicles in the 6,000 pound to 10,000 pound (gross vehicle weight) range. These standards, when set, would encourage improved fuel economy of light trucks in two ways. First, by establishing a set of fuel-economy standards and noncompliance penalties for light trucks, a clear economic and legal signal is given to manufacturers of light trucks to comply with the standard. Second, the standard to be set under the Energy Policy and Conservation Act would also serve as the dividing line between light truck taxes and rebates for light trucks under the President's energy plan, thus giving light truck manufacturers a reinforcing set of economic incentives to meet (and exceed) whatever fuel-economy standard is set for them. Together, these incentives have the potential to be very effective in conserving fuel in light trucks. It is impossible to provide estimates of their effect at this stage, however, since the standards themselves have not yet been set by the Secretary of Transportation.

Standby Gasoline Tax

Probably the most controversial proposal in the President's energy package is the standby gasoline tax. Under this program, at the end of each year starting with 1978, actual nationwide gasoline consumption would be compared to the predetermined consumption target. If actual consumption is found to exceed the target consumption, a gasoline tax of five cents per gallon would be imposed for each full percentage point by which the actual consumption exceeds the target. However, year-to-year changes are limited so that the tax never changes by more than five cents from the previous year. If the standby tax were to grow at the maximum possible rate under this constraint, the tax could start at five cents per gallon in 1979 and reach a level of 50 cents per gallon by 1980, in current dollars.

The proposed target levels of consumption increase from 7.35 million barrels per day in 1978 to 7.45 million in 1980 and then decline rapidly to 6.6 million barrels per day in 1985 and 6.5 million barrels in 1987 (see Table VI-1). For comparison, actual 1976 gasoline consumption is estimated to be 7.0 million barrels.

TABLE VI-1. PROPOSED TARGET LEVELS FOR NATIONAL GASOLINE CONSUMPTION, AVERAGE DAILY CONSUMPTION IN MILLION OF BARRELS

Year ^{a/}	Target
1978	7.35
1979	7.40
1980	7.45
1981	7.40
1982	7.20
1983	7.00
1984	6.80
1985	6.60
1986	6.55
1987 and thereafter	6.50

SOURCE: H.R. 6831, Section 1221c, Title II, Part B.

^{a/} For 12-month period ending September 30.

The standby gasoline tax would probably not have any effect until the early 1980s. Fuel-economy improvements already in evidence in model year 1977 vehicles as well as anticipated fuel-economy improvements between now and 1980 lead to a forecast of auto gasoline consumption that increases from 1976 to 1978, levels out through 1980, and then declines slightly between 1980 and 1986. Thus, the target proposed in the Administration plan appears to reflect the general shape of the trajectory expected for future automobile gasoline consumption. Since the standby gasoline tax would be triggered by overall gasoline consumption, however, (not just automobile gasoline consumption) the gasoline used for other purposes must be taken into account when analyzing the likelihood that the standby gasoline tax would be triggered in any given year.

Trucks are the principal nonautomobile users of gasoline. In 1972 trucks used about 20 percent of the nation's gasoline. Of this, more than half was used by light-duty trucks such as

pick-ups, vans, and recreational vehicles. Light-duty trucks have been growing in number by more than 5 percent a year during the last decade. A continuation of this growth trend would lead to increases in fuel consumption that more than offset automobile fuel savings in 1985, as discussed below under the analysis of energy impacts.

ENERGY IMPACTS

Options Examined in this Report

Using an econometric model, 5/ forecasts are developed for each of five different policy options. These five options represent present policy and four combinations of proposals from President Carter's proposals.

Option 1 (Present Policy):

Present policy reflects the imposition of the EPCA (although not necessarily assuming attainment of the standards contained therein) and assumes that, except for a gradual relaxation of price controls, gasoline prices increase at the rate that inflation increases.

Option 2 (Crude Oil Equalization Tax):

Implementation of the crude oil equalization tax.

Option 3 (Gas Guzzler):

Implementation of both the crude oil equalization tax and the new car excise taxes/rebates of the President's package.

Option 4 (Full Package):

Implementation of all provisions within the President's energy package (i.e., crude oil equalization tax,

5/ For details, please refer to Marketing and Mobility, report of a panel of the Interagency Task Force on Motor Vehicle Goals Beyond 1980, March 1976; and Damian Kulash, "Forecasting Long-Run Automobile Demand," in Transportation Research Board Special Report 169, 1975, pp. 14-19.

gas-guzzler excise taxes and rebates, and the standby gasoline tax.) This option assumes that the standby gasoline tax is triggered in each year from 1982 to 1981.

Option 5 (Fully Triggered Tax):

Implementation of all provisions of the President's energy package, assuming that the standby gasoline tax is triggered from 1979 to 1988. This option represents the most restrictive outcome possible under the standby gasoline tax and is not judged to be a likely outcome.

Present Policy Forecast for the Auto Sector

The impacts of President Carter's energy program should be gauged in terms of shifts from what would be expected in the absence of his program. In view of changing technology, rising population, and increasing affluence, automobile usage and the associated fuel consumption will differ from previous usage and consumption. The increase in gasoline prices of recent years and the existence of the standards required by EPCA will also play significant roles in shaping that future.

Under present policy, vehicle miles of travel are expected to increase more rapidly than new car sales, fleet size, or use of gasoline by automobiles. Travel growth is projected to average nearly 3.2 percent per year between 1977 and 1985. The stock of cars is forecast to grow somewhat more slowly, around 1.9 percent per year less than the very rapid growth experienced in the late 1960s and early 1970s. Its tapering off is attributable to several factors:

- o a decline in the rate of increase of driver-age population;
- o increases in automobile operating costs;
- o increases in automobile purchase prices; and
- o the existence of near-saturation levels of auto ownership among upper-income groups.

This slow growth in the number of cars translates into an almost level pattern of auto sales from now until 1985. Under present policy, new car sales are not projected to vary by more than 3.5 percent from their current level throughout the next decade.

In spite of the 32 percent growth in vehicle miles of travel forecast between 1977 and 1985, total auto fuel consumption is expected to change only slightly. As vehicles with improved fuel efficiency are phased in, the historic pattern of annually increasing automotive fuel use is expected to reverse itself. Auto fuel consumption is expected to peak in 1978 at about 5.4 percent above the 1976 level, then fall to about 0.7 percent above the 1976 level in 1985, and to begin to increase again in the late 1980s. The slight growth and eventual decline of auto gasoline usage between now and 1985 is primarily attributable to fuel economy improvements made in response to the fuel-economy provisions of the EPCA and to today's gasoline prices (which are considerably higher than those which prevailed when most existing cars were manufactured). The average fuel economy of new cars is projected to rise from 18.3 mpg in 1978, to 20.5 in 1980, and to 23.3 in 1985. These gains in new car fuel economy imply that the fuel cost per mile of model year 1985 cars will be 30 percent lower than that of model year 1976 cars. Along with increasing affluence, this decrease in projected fuel cost per mile is expected to increase auto travel per household from 15,000 miles per year in 1976 to 18,000 miles per year in 1985.

Future truck gasoline consumption under a continuation of present policy is difficult to predict for two reasons. First, as noted earlier in this chapter, it is not yet clear how stringent the EPCA truck fuel-economy standards will be. Thus, their impact on truck fuel consumption is still unclear. Second, increases in the diesel-powered share of trucks will reduce truck demand for gasoline, but the extent to which the diesel share will increase in future years is subject to considerable uncertainty because of technological, environmental, and regulatory questions.

It has been assumed here that truck gasoline consumption increases 1.6 million barrels per day in 1976 to 1.9 million barrels per day in 1980, to 2.2 million in 1985, and to 2.6 million in 1990. This assumption, based upon a forecast made

for the Federal Energy Administration, 6/ reflects expected increase in trucking activity, modest increases in the share of diesel trucks (for example, the diesel share of heavy trucks increases from 61 percent in 1973 to 84 percent in 1985,) and no increases in truck fuel economy. In view of the light truck provisions of the Energy Policy and Conservation Act and other conservation actions being taken by truckers, the future truck fuel consumption assumed here is probably conservative, that is, higher than what would be expected if these initiatives are successful. Nevertheless, it is adopted here in order to gauge the maximum possible impact of the standby gasoline tax. That is, to the extent that this forecast may overstate future truck gasoline consumption, the future total gasoline consumption which it implies will be high, with the result that the standby gasoline tax is projected to be triggered earlier than it probably would. Correspondingly, the effect of this assumption about truck fuel consumption is to examine the standby gasoline tax proposal in the strongest form it could take.

Although the automobile fuel consumption projected above implies a downturn in the nation's gasoline consumption during the early 1980s, taken together with the truck fuel consumption projections of the preceding paragraph, the result is gasoline consumption substantially above the targets for the mid-1980s put forth in President Carter's energy proposals.

Estimated Fuel Savings

Under present policy, (which includes the EPCA new car fuel-economy standards) automotive gasoline consumption will probably increase by 1.2 percent per year until 1980, decrease by about 0.8 percent per year from then to 1985, and then begin increasing again by 0.3 percent per year from 1985 to 1990. Table VI-2 shows expected gasoline savings resulting from adding various components of the energy package to present policy. These findings indicate:

- o Option 2: The crude oil equalization tax by itself would likely save only minimal amounts of gasoline

6/ Jack Faucett Associates, Trucking Activity and Fuel Consumption: 1973, 1980, 1985, and 1990, report submitted to the Federal Energy Administration, June 1976.

TABLE VI-2. PROJECTED GASOLINE CONSUMPTION UNDER PRESENT POLICY AND ALTERNATIVE OPTIONS: PRESENT CONSUMPTION AND CHANGES (MINUS) IN THOUSANDS OF BARRELS PER DAY

Option	1978	1980	1985	1990
1. Present Policy EPCA Standards ^{a/}	7,390	7,530	7,650	8,160
2. Crude Oil Equalization Tax	-10	-40	- 25	0
3. Crude Oil Equalization Tax, Excise Taxes and Rebates	-20	-55	-240	-450
4. Crude Oil Equalization Tax Excise Taxes and Rebates, and Partial Gas Tax (level of tax)	-20	-55	-305 (20 cents)	-650 (45 cents)
5. Crude Oil Equalization Tax, Excise Taxes and Rebates, and Full Gas Tax (level of tax)	-20	-120 (10 cents)	-390 (35 cents)	-710 (50 cents)

SOURCE: Congressional Budget Office.

^{a/} Figures shown for present policy refer to projected consumption levels; figures for the other cases refer to differences relative to present policy.

by 1978, but by 1980 would save about 40,000 barrels per day and about 25,000 per day in 1985.

- o Option 3: By adding auto excise taxes and rebates onto the crude oil equalization tax, the gasoline savings would become quite substantial, beginning with 55,000 barrels per day in 1980 and rising to 240,000 in 1985 and 450,000 by 1990. (This option would increase savings by about 15,000, 215,000, and 450,000 barrels per day over Option 2 for 1980, 1985, and 1990 respectively.)
- o Option 4: The standby gasoline tax, which most likely would not begin before 1982, would, combined with the crude oil equalization tax and the excise tax/rebates, save about 305,000 barrels per day in 1985 and about 650,000 by 1990. (This option would increase savings by about 65,000 and 200,000 barrels per day over Option 3 in 1985 and 1990.)
- o Option 5: In conjunction with the crude oil and excise tax/rebate provisions, a gasoline tax triggered in 1979 by much stricter consumption standards could produce substantial gasoline savings much earlier: 120,000 barrels per day could be saved by 1980, 390,000 by 1985, and 710,000 by 1990; if the full five cent per gallon increase in the gasoline tax were imposed every year. (This option would increase savings by about 65,000, 85,000, and 60,000 barrels per day over Option 4 for 1980, 1985, and 1990 respectively.)

Options 4 and 5 reflect two possible outcomes under the standby gasoline tax, namely, that it would be triggered from 1982 on and from 1979 on, respectively. CBO projections indicate that, in 1990, the standby gasoline tax would add 200,000 barrels per day to the gasoline savings of the other proposals in the President's package, assuming that it is triggered from 1982 on and reaches a value (in current dollars) of 45 cents per gallon in 1990. The corresponding projection assuming triggering from 1979 on is 260,000 barrels per day in 1990. These projections suggest that the standby tax could have substantially different effects on fuel conservation depending upon when it would take effect. Furthermore, the determination of when it would take effect is strongly influenced by what happens to future gasoline consumption by trucks.

Option 4, which assumes that the standby gasoline tax would be triggered from 1982 on, is consistent with a very conservative view of future energy conservation by trucks. As was discussed earlier under the description of the present policy case, it is assumed here that the diesel share of heavy truck sales increases from 61 percent in 1973 to 84 percent in 1985, and that there are no gains in the fuel economy of light trucks. Both of these assumptions understate the extent of gasoline conservation likely to be achieved by the trucking industry. CBO estimates that, under the light truck standards of the Energy Policy and Conservation Act and the reinforcing taxes and rebates for light trucks proposed in the President's energy plan, it would be possible to obtain reductions in truck use of gasoline sufficient to delay triggering of the standby gasoline tax until 1984 and possibly even until 1985. It is difficult to attribute savings in gasoline consumption by trucks to the Administration plan versus present policy since both are based on the same, yet to be determined, fuel-economy standards for light trucks. It is clear, however, that these policies regarding trucks would exert a strong influence on the triggering mechanisms of the standby gasoline tax.

It should be noted that the standby gasoline tax would not apply to diesel-powered vehicles, apparently as an incentive to encourage greater diesel use. While diesel engines are generally more fuel-efficient than gasoline ones, their efficiency advantage does not appear to be very substantial for light vehicles in local use. ^{1/} Exclusion of diesel-powered vehicles from the standby gasoline tax would thus encourage some shifts to engines that save gasoline but would have little effect on overall petroleum product conservation.

The reduction in gasoline consumption projected under the standby gasoline tax would come largely through reductions in vehicle miles of travel. In the most restrictive case (including a gas tax starting in 1979 as in Option 5), travel reductions relative to present policy would be small until about 1980, but increase to about 4 percent in 1985 and 5 percent in 1990. These travel reductions are thought to be indicative of only minor traveler inconveniences since they represent declines in travel growth per household relative to what would be expected under present policy, not absolute reductions from current levels.

^{1/} See Jack Faucett Associates, *op. cit.*

OTHER IMPACTSImpact on Motor Vehicle Manufacturers

President Carter's proposals would influence the auto manufacturers in two major ways: (1) by encouraging the manufacturers themselves to make changes in autos that result in greater fuel efficiency; and (2) by encouraging consumers to alter the number and type of cars they purchase.

Table VI-3 shows that both increases in gasoline prices and the new car excise tax/rebate scheme would reduce the number of

TABLE VI-3. PROJECTED AUTO SALES UNDER PRESENT POLICY AND
ALTERNATIVE OPTIONS: PRESENT SALES AND CHANGES
(MINUS) IN THOUSANDS OF AUTOS

Option	1978	1980	1985	1990
1. Present Policy, EPCA Standards ^{a/}	11,660	12,090	11,620	12,180
2. Crude Oil Equalization Tax	-120	-370	- 80	0
3. Crude Oil Equalization Tax, Excise Taxes and Rebates	-140	-360	-360	-160
4. Crude Oil Equalization Tax, Excise Taxes and Rebates, and Partial Gas Tax	-140	-360	-990	-1,240
5. Crude Oil Equalization Tax, Excise Taxes and Rebates, and Full Gas Tax	-140	-1,000	-1,210	-1,220

SOURCE: Congressional Budget Office.

^{a/} Figures shown for present policy are projected auto sales; figures for other years refer to differences relative to present policy.

autos sold in future years beneath the levels anticipated under present federal policy. This reduction is caused in part by expensive technological improvements that would be made by manufacturers under the Administration's plan (and whose cost would be passed along to consumers) in order to increase the amount of the rebate for which each new car is eligible. The decline in new unit sales would also be partly attributable to the increase in the cost per mile of fueling vehicles that would emerge under the President's proposals. By 1985, the President's package would increase the fuel efficiency of new cars by 12 percent above present policy, while the price of gasoline (including the standby gasoline tax triggered in 1982) would increase by 22 percent. Taken together, these factors would increase the cost per mile of fuel for new cars relative to present policy about 10 percent. As a result of the increased purchase cost and fueling cost of automobiles under the Administration program, the projected reductions in new cars sold relative to present policy would range from as little as 80,000 autos or 0.7 percent of anticipated new car sales in 1985 if only the crude oil taxes are imposed (Option 2) to as much as 1.2 million autos or 10.4 percent of new car sales if the crude tax is combined with the excise tax/rebate system and the imposition of maximum increases in the standby gasoline tax (Option 5). However, imposition of the excise tax/rebate proposal alone would probably increase unit sales slightly in the first few years.

Even though the number of new cars sold would decrease under the President's proposals, relative to present policy, the sales revenue of the auto industry adjusted for penalties under the Energy Policy and Conservation Act would probably remain about the same. The principal reason why auto industry revenues would not fall under the program is because of technological improvements made in response to the gas-guzzler excise taxes and rebates. CBO expects that these improvements would add between \$400 and \$600 to the price of new cars in 1985, thereby producing additional new car sales revenues almost equivalent to those lost through the decline in the number of new cars sold. Furthermore, penalty liabilities for noncompliance with the Energy Policy and Conservation Act are projected to be about \$1.3 billion lower in 1985 under the President's plan. If auto industry revenues were adjusted to reflect penalty liabilities, the President's plan would produce adjusted 1985 auto industry revenues that would be almost identical to those projected under present policy.

The effect that the President's proposals would have on the profits of the auto manufacturers is not clear. Under most options, auto unit sales would decrease, perhaps reducing the profit margin on each vehicle sold. Under most options the intermediate and large car proportion of new auto sales would increase even faster than under present policy, however (see following section). Since profit margins are thought to be greater on large autos, and since U.S. firms produce the vast majority of these vehicles, the profitability of U.S. auto manufacturers might not be impaired by the proposed auto energy controls.

The influence of the proposed energy package on auto imports cannot be estimated until the policy on rebates for fuel-efficient imports is clarified.

Mechanism of Influence of Auto Sales

The increase in gasoline prices and the system of excise taxes/rebates proposed by President Carter appear to affect the auto industry in different ways. As gasoline prices would be increased (either through the crude oil provisions or through triggering of the standby gasoline taxes), total auto sales would be decreased relative to sales anticipated under present policy as well as relative to alternative energy proposals that include the excise tax/rebate system.

In addition, increased gasoline prices would tend to encourage a shift in market share away from small cars and toward larger cars that are relatively fuel-efficient. (Of course, these new larger cars would be substantially more fuel-efficient than current ones.) This somewhat counter-intuitive result would occur because it is easier (and relatively less expensive) to make large percentage improvements in the fuel efficiency of large cars as compared to the already efficient small cars. Therefore, the combined cost of buying and fueling large cars would be increased relatively less than the corresponding cost for small cars. The smaller relative cost increase for large cars would thus encourage a greater proportion of consumers to buy large cars than would have been the case with no cost increase at all. This effect is magnified by the fact that small car buyers are more price-sensitive than are large car buyers.

In general, the proposed system of excise taxes and rebates is projected to encourage the purchases of small cars relative to the number estimated to be purchased under present policy and relative to the number purchased under proposals which increase gas prices. The market share of large cars projected under the gas-guzzler provisions would be reduced relative to options which include significant gas price increases. A combination of excise taxes with even a small increase in gas prices (for example, with the crude tax only as in Option 3) tends to increase the market share for large cars relative to present policy.

The proposed excise tax/rebate system would probably influence the auto manufacturer more than it would the auto purchaser. For example, most of the rebates would not be fully passed on to consumers in the form of lower prices for existing models; but some of the rebates would, in effect, be absorbed by manufacturers in making technological improvements that result in even more fuel-efficient models, that is, vehicles that can qualify for larger rebates.

Used Car Market

Changing the prices of new cars in turn changes the prices of used cars as well as the dynamics of the used car market. An excise tax on larger, less fuel-efficient autos would increase somewhat the value of existing cars of this type and discourage people from junking them. Under the existing EPCA standards, these gas guzzlers will become increasingly rare, however, so that the additional effect on fuel consumption associated with delayed scrappage is likely to be minor.

Similarly, rebates for new small- and medium-size autos that are fuel-efficient should decrease somewhat the value of existing cars of this type. This effect would be reduced since much of the rebates would likely be used by the manufacturers to make changes that improve auto fuel efficiency.

Increased gas prices would probably have the opposite effect on the used car market--encouraging a more rapid turnover of inefficient autos and a longer retention of fuel-efficient autos. Taken together, changes in vehicle scrappage patterns are not expected to have significant implications for the nation's fuel consumption. In 1985 even the most extreme of the energy options (Option 5) is projected to decrease the number of autos scrapped by less than 1.2 percent.

Penalty Liabilities on Industry

Individual auto companies must make penalty payments if their car sales do not meet the fuel-efficiency standards set by the Congress under the EPCA. ^{8/} It appears that the system of auto excise taxes and rebates proposed by President Carter would have a major effect in reducing the auto industry's overall penalty liability and in moving the industry as a whole toward meeting the EPCA standards. Under present policy the auto industry is projected to be liable for penalty payments of \$2.5 billion in 1985 (in 1977 dollars). Options 3, 4, and 5 (which include the excise tax/rebate system) would reduce the penalty liabilities by more than one-half, to between \$1.05 billion and \$1.21 billion in 1985.

Consumer Impacts

The shifts in crude oil price controls, the increase in crude oil taxes, and the standby gasoline tax would all translate into higher gasoline prices for consumers relative to those anticipated under present policy. Most motorists would simply pay these higher gasoline prices and continue driving much as before; some would curtail their driving; and a few would find that the increased gasoline prices made it no longer worthwhile to buy a second car or replace cars as often. CBO projections indicate that vehicle miles of travel would fall by 4.2 percent in 1985 as a result of the full Administration package, including a fully triggered standby gasoline tax. The gas-guzzler provisions are not expected to have any noticeable impact on the total vehicle miles of travel. The crude oil equalization taxes by themselves would lead to a reduction in 1985 auto travel of under 0.5 percent.

The number of cars in use would decrease slightly under the gas-guzzler taxes and rebates, although the drop appears to be only about 1.3 percent in 1985. The standby gasoline tax (if it is fully triggered) is the only element in the Carter package which promises to have a significant impact on automobile ownership patterns. The full gas tax combined with the other parts of

^{8/} These penalties equal \$50 per car for each mile per gallon by which a manufacturer's average new car mpg falls short of the standard. These civil penalties are not tax deductible.

the proposal could lead to a drop of 6.1 million cars in use by 1985, about 5.4 percent under the level expected under present policy.

It is difficult to project who will bear the brunt of the reduced travel and auto ownership that result from the Administration proposals, specifically from the standby gasoline tax. High-income groups would face the largest total travel price increases because they tend to own more cars per household, to use each car more, and to buy large cars that are relatively fuel inefficient. While these figures clearly indicate that relatively high-income households would encounter the greatest net price increases, they are also, however, clearly the households that are least inconvenienced by these extra charges. Low-income households whose fuel use is much lower could nonetheless curtail their travel the most. The evidence available on the effects of gasoline price increases on different income groups is discussed in detail in Chapter X.

DISTRIBUTIONAL IMPACT

There are several factors that would be likely to reduce the potentially regressive nature of increased gasoline prices. Most significantly, the revenues from the gas tax and crude oil provisions would be rebated on a per capita basis, regardless of automobile ownership. Families with no auto would receive the full rebate, and since these families are concentrated at lower incomes, the system of rebates would represent a transfer of income to them. In 1973, only 36 percent of families with incomes under \$3,000 owned a car, compared to over 90 percent car ownership by families with incomes over \$10,000. ^{9/} Also, because the sum to be rebated to individuals would include a part of the taxes paid by business, all income groups should receive larger rebates than their increased gas payments. A major offset to this rebate would be the likely increased prices for consumer goods as trucking firms and others pass on their increased fuel costs. These increased prices are addressed more fully in Chapter X.

Under present policy, significant improvements are expected in the fuel efficiency of new cars so that by the late 1980s,

^{9/} Bureau of Labor Statistics, Consumer Expenditure Survey Series: Interview Survey, 1972 and 1973, Table 16b.

when the nation's vehicle fleet as a whole should be about 30 percent more fuel efficient than now, families at virtually all income levels should be able to drive the same vehicle miles as today, for a lower expenditure on gasoline. (Of the options examined here, the only exception is if the standby gas tax is fully triggered, resulting in a 5 percent increase in gas cost per vehicle mile in 1985 over 1976.) Since higher-income families purchase a larger proportion of new cars than lower-income groups, they would be the first to receive these gains in fuel efficiency, however. In time, as new cars pass through the used car market, all income groups would enjoy these fuel-efficiency gains.

The President's proposals would improve average fuel efficiency of new cars over the gains likely to occur under present policy by about 12 percent in 1985, leading to an improvement in the average fuel efficiency of all cars of 1.6 percent relative to present policy. For the average consumer, these efficiency gains would be more than offset by increased gas prices, however, increasing the fuel cost per mile relative to that expected under present policy. But because of the significant improvements in average miles per gallon expected under the existing EPCA standards, the Administration proposals would still result in an improvement relative to today's conditions in gasoline costs per vehicle mile.

The increased gasoline prices would have different effects depending on where people live. Since people living in central cities are less apt to own cars (32 percent of central city inhabitants own no car versus 15 percent for other urban areas and 18 percent for rural families), more central city dwellers would receive rebates and yet bear relatively minor cost increases. Also, since public transportation is better in urban areas, it should be easier to shift some work-related trips from auto to public transit. In general, rural families with autos already spend a larger portion of their income on gasoline than do similar urban families.

BUDGETARY IMPACTS

Federal Budget

The direct impact on the federal budget of the gas price and new car excise tax/rebate proposals is planned to be neutral. Rebates would be adjusted annually so that total auto rebates

offset total auto excise taxes. Any temporary imbalances would be absorbed by the Treasury, but would likely to be small (perhaps \$50 million at most) and of little significance to the federal budget. Similarly, revenues from the standby gas tax (if and when it is imposed), would be returned to consumers through the income tax system and other mechanisms.

The revenues generated by the standby gas tax could be quite substantial. Using the proposed gasoline consumption targets, a five cent per gallon tax would likely be imposed in 1982, increasing to 20 cents in 1985 and 45 cents in 1990. A tax at these levels would produce about \$3.3 billion in 1982, \$11.2 billion in 1985, and \$19.9 billion in 1990 (in 1977 dollars), net of revenue losses due to business claiming the gas tax as an itemized deduction on their income taxes.

The energy provisions would have an important impact, however, on the ability of the auto manufacturers to meet the existing EPCA auto-efficiency standards, and thus on the penalty payments they are required to make. With no changes in existing law, penalty payments could equal \$2.5 billion in 1985. The influence of the crude oil provisions on the price of gas should lower this by only about \$15 million. Adding the excise tax/rebate system would, however, significantly improve the extent to which the auto industry is likely to meet the EPCA standards, reducing the expected 1985 penalty liabilities to between \$1.05 and \$1.21 billion. The federal budget might also be increased by as much as \$0.7 billion in 1985 and \$1.3 billion in 1990 if additional aid were provided to replace state revenue losses caused by decreased state and local gas tax receipts and other highway-related receipts. This problem is discussed in the next section.

State Budgets

Reductions in automotive gasoline consumption under the President's plan would be accompanied by adverse effects on state (and possibly local) budgets. Fuel tax revenues, auto license fees, and titling fees and taxes would all be reduced. Highway tolls would also be affected. There might also be a slight change in sales tax receipts, but this is indeterminate since consumers would simply spend roughly the same proportion of their incomes on a different market basket of goods and services, most of which would also be subject to sales taxes. Table VI-4 shows estimated state revenue losses in each option examined. There is no easy way to determine the share of losses on a state-by-state

basis, although some would be more severely affected than others. The most restrictive combination of President Carter's proposals (Option 5) could reduce state receipts by 0.4 percent, 2.5

TABLE VI-4. IMPACTS OF ENERGY PROPOSALS ON STATE BUDGETS:
IN MILLIONS OF DOLLARS

Option	Direct Auto-Related Revenue Changes Compared to Present Policy a/			
	1978	1980	1985	1990
1. Present Policy b/	10,500	10,600	10,460	10,670
2. Crude Oil Provisions	-25	-90	-55	0
3. Crude Oil Provisions, Excise Tax/Rebates	-40	-120	-380	-640
4. Crude Oil Provisions, Excise Tax/Rebates, Partial Gas Tax	-40	-120	-540	-1,130
5. Crude Oil Provisions, Excise Tax/Rebates, Full Gas Tax	-40	-270	-740	-1,270

SOURCE: Congressional Budget Office.

a/ Includes decreased fuel tax revenues, auto license and registration fees, and title fees and special titling taxes.

b/ Figures shown for present policy are projected auto-related state revenues; figures for other years refer to differences relative to present policy.

percent, 7.1 percent, and 11.9 percent in 1978, 1980, 1985, and 1990 respectively relative to present policy. 10/

The federal government might wish to consider state aid packages to make up these losses. Since many of the state losses would fall in revenue areas that are earmarked by law for highway use, one option would be to provide a system of block grants to the states, some of which would be tied to highway spending but not be tied to new highway construction. This could reduce the impact of the energy proposals on the state money available for maintenance of highways. Grants could be apportioned by a formula that attempts to simulate revenue losses by state.

SUMMARY OF PRINCIPAL IMPACTS OF THE PRESIDENT'S PROPOSALS

Of the three proposals in the President's energy program shown in the following figure, the gas-guzzler excise taxes would have the largest effect on fuel consumption, reducing automotive gasoline consumption in 1985 by 215,00 barrels a day. This saving could reach 450,000 barrels of gasoline a day in 1990. Because the gas-guzzler provision influences the type of new car produced by manufacturers and purchased by consumers, it would take a number of years for it to have an appreciable impact on gasoline consumption. At the same time, its effect on total car sales should be relatively minor, reaching a maximum reduction of about 280,000 new cars sold in 1985.

The standby gasoline tax appears unlikely to be triggered before 1982, and, in constant 1977 dollars, could reach as much as 23 cents per gallon in 1990. Under optimistic assumptions about diesel penetration and standards for light-duty trucks, the tax might not be triggered until 1984 or 1985. If the standby gasoline tax is triggered in 1982, it could reduce auto gasoline consumption by an additional 65,000 barrels a day in 1985 and 200,000 barrels a day in 1990.

10/ State governments are expected to spend about \$13.7 billion in highway-related tax receipts on highways in calendar year 1977. This sum includes truck-related taxes and parking charges and tolls that are not included in the estimates in Table VI-4. Local governments are expected to spend an additional \$600 million in highway-related receipts. (Federal Highway Administration News Release, December 31, 1976, Table HF-11.)

Projected Gasoline Savings of the President's Energy Proposals
(Savings refer to gains relative to present policy.)

Savings in Thousands
of Barrels Per Day

In contrast to the gas-guzzler provisions, which would reduce new car sales by about 280,000 units in 1985, the standby gasoline tax could have a large impact on new car sales, reducing them by over 600,000 units in 1985. Total vehicle miles travelled could also be reduced by 1.7 percent in 1985 because of the standby gasoline tax.

As a whole, the President's proposals would reduce auto gasoline consumption compared to present policy by about 55,000 and 305,000 barrels per day in 1980 and 1985, respectively. New car sales would be reduced by a total of about 360,000 and 990,000 units in 1980 and 1985, respectively. Vehicle miles travelled would be reduced by 0.8 percent in 1980 and 2.3 percent in 1985 relative to present policy.

 CHAPTER VII. HOME INSULATION AND SOLAR HEATING TAX CREDITS

President Carter's proposed tax credits for insulation and solar equipment would help reduce private consumption of energy for heating the nation's homes. However, they would do so at sharply different costs. For each barrel of oil not burned because of responses to the insulation credit, the federal government would pay \$2.42 to taxpayers who insulate. For the solar credit, the figure is \$11.28 per barrel of oil not burned. These costs are high because a large portion of the credits are paid to people who would have made energy-saving improvements anyway.

Between 1978 and 1985, the proposed insulation tax credit would reduce federal revenues by \$2.1 billion. This tax expenditure would induce people to spend \$2.9 billion on insulation, in addition to the \$6.3 billion that would be spent without the tax credit. ^{1/} Of the 23.8 million households making insulation improvements, 7.8 million are expected to do so in response to the proposed credit. The 7.8 million who insulate only in response to credit would save themselves \$9.2 billion in heating costs by the year 2004. ^{2/} Without the proposed credit, consumers would (on average) save \$3 in

^{1/} The National Energy Plan (NEP) states that homeowners would be entitled to the insulation credit. The bill (H.R. 6831) submitted to the Congress does not exclude renters from claiming credits. This chapter proceeds on the basis that H.R. 6831 reflects the Administration's intent on this point. Even if the credit is available to renters, few of them are expected to make these improvements. Rental leases typically are shorter than the payback period for these investments.

^{2/} The \$9.2 billion is the present value of a saving of 890 million barrels of oil (or equivalent) in 7.8 million homes over a 27-year period.

heating costs by investing \$1 in insulation. The credit would raise the return to \$4 for \$1 invested in insulation.

During the same period, the solar tax credit would add \$460 million to the \$700 million that would be spent for solar equipment without the credit. By 1985, 773,000 households (compared to the Administration goal of 2.5 million) would own solar equipment. Without the credit, the number would be only 464,000. Tax credits from 1978-1985 (amounting to \$262 million) would lead to \$460 million of increased private investment, and would save the 309,000 affected homeowners ^{3/} \$240 million over a 27-year period. From a private perspective, investment in solar equipment barely repays its costs for most buyers, even with the proposed tax credit.

The costs and benefits of energy-saving investments for residences can be compared as cash amounts--the cost of improvements vs. the amount of fuel savings. Public costs can also be stated in dollars--the estimated tax credit. The public benefits, however, come in a less tangible form--one that cannot easily be reduced to a dollar value. The public benefit from reducing private energy purchases comes in the form of reduced national energy consumption (i.e., reduced consumption of oil and gas) and an implied decrease in imports, which reduces vulnerability associated with dependence on foreign energy. Measured by its impact on private energy consumption, the insulation tax credit is 4 1/2 times as efficient as the solar credit. Yet, neither tax credit may provide a sufficient public benefit to justify the public cost.

PROPOSED POLICY

Residential heating (space and hot water) accounts for 10 percent of total energy use in the United States. A reduction in the use of conventional fuels for these purposes would be desirable for many of the same reasons that reductions are sought in other sectors. Improved levels of insulation

^{3/} The solar credit is not specifically limited to owners, but few tenants are expected to invest in costly equipment for premises that they do not own.

and weatherproofing are highly efficient means for bringing about reductions (perhaps 30-40 percent) in the consumption of heating fuels. In addition, the increased use of solar heating equipment offers the potential to shift some heating demands away from conventional fuels.

Increased use of insulation and solar equipment may be encouraged in a number of ways, including:

- o raising fuel prices
- o educating the public
- o setting mandatory standards
- o subsidizing manufacturers
- o granting tax credits
- o offering direct grants.

The Administration plan focuses primarily on the tax credit strategy (although there are some educational efforts, direct grants, and minor price increases as well).

The proposed incentive for adding insulation and related equipment consists of a tax credit equal to 25 percent of the first \$800 spent, and 15 percent of the next \$1,400 spent to improve primary residences. The maximum allowable credit per household is therefore \$410. Major items eligible for the credit include insulation, storm windows, and clock thermostats. Some weather stripping, caulking, and miscellaneous improvements to heating equipment are also included.

The proposed incentive for solar equipment consists of a tax credit for solar space heating and solar water heating installations. The tax credit would initially be set at 40 percent of the first \$1,000 of expenditures and 25 percent of the next \$6,400 spent for eligible equipment. It would decline over time and expire at the end of 1984. The maximum credit

would be \$2,000 through 1979, \$1,580 through 1981, and \$1,210 through 1984. 4/

The home insulation and solar heating tax credits have at least one short-run goal--to speed the purchase and installation of certain materials and equipment--and at least one long-run goal--to reduce the use of scarce and costly conventional fuels for home heating. There is widespread acceptance of the fact that additional insulation and related weatherproofing can reduce heating fuel needs by 30 to 40 percent. In the case of solar heating, recent research and engineering experiments suggest that solar heating, despite high initial costs, is beginning to be competitive with conventional heating systems. 5/ In both instances, reduced fuel use will lessen the need for imported petroleum products.

ENERGY-SAVING IMPACT OF INSULATION CREDITS

The purchase of insulation and related materials after the effective date of the proposed tax credit will undoubtedly produce significant reductions in energy consumption. However, not all future reductions in energy usage should be attributed to the proposed tax credit. The proportion of future residential energy savings properly attributed to the tax credit depends on how many households will still respond to past increases in heating costs.

Motivation to Insulate

Generally, people are motivated to buy and install added insulation as a result of fuel cost increases--including

- 4/ These reductions are based on the assumption that equipment and related costs will decline as the relevant technology improves, reducing the need for large subsidies to purchasers.
- 5/ Cost comparisons between solar heating and conventional systems are best made by comparing payments necessary to repay a loan for the initial solar cost (amortized) with the initial cost plus the expected operating cost (largely fuel) of the conventional system.

those expected in the future (a tax credit merely adds to the impetus). 6/ Nevertheless, long delays often occur between recognition of fuel price increases and the purchase of added insulation. Many people are just now responding to fuel cost increases occurring years ago, and expectations about future energy costs will contribute to insulation sales for many years to come, even without a tax credit. 7/

Given the normally long response lags between fuel price increases and insulation purchases, a large share of any tax credit would be a windfall payment to people who have already decided to add insulation. It is estimated that two-thirds of the households receiving the credit would have bought insulation anyway.

The Demand for Insulation

Some 34 million dwelling units in the United States (all suitable candidates for improved insulation) are the target of the proposed credit. 8/ This figure is calculated as follows. First, of 45 million owner-occupied dwellings, an estimated 38 million are suitable for additional insulation (i.e.,

6/ Insulation sales began a sharp rise in 1974, with the rapid increase in heating fuel costs. In the intervening three years, insulation sales have shown no sign of tapering off. There is no reason to assume that sales would show a marked drop without the proposed tax credit.

7/ The literature on diffusion of technology and adoption of innovations suggests long lags and incomplete implementation, even though the savings from adding insulation are substantial. See Rogers and Shoemaker, Communication of Innovations, New York, 1971, especially pp. 129 and 350-352.

8/ The NEP includes a number of insulation measures in addition to tax credits, including utility-sponsored programs, grants to low-income households, and the prospect of mandatory standards. This analysis seeks to identify the cost and effectiveness of the proposed credit apart from the other related, but separable, initiatives aimed at the same objective.

have accessible attics). Approximately 8 million of these dwellings have already been upgraded since 1974. Thus, 30 million owner-occupied homes remain to be insulated. Second, of nearly 25 million rental housing units, an estimated 11.5 million are suitable for additional insulation. Among these 11.5 million, approximately 4.0 million are occupied by people who stand to benefit from the tax credit. 9/ Thus, a total of 34.0 million dwelling units are the possible focus of the insulation tax credit.

The fact that 8 million homeowners purchased insulation between 1974 and 1976 in response to increased heating costs indicates that insulation will be purchased even without the tax credit. These recent purchases are estimated to represent only a fraction (about one-third) of the eventual response to the 90 percent increase in fuel prices experienced since 1974. Therefore, an additional 16 million homes are expected to be insulated by 1985, even without a tax credit. The proposed credit (which would reduce the cost of insulation by 25 percent) would encourage still other homeowners and renters to make energy-saving improvements. Under assumptions used here, it would lead to insulation purchases by 7 million more homeowners and 0.8 million renters. Another 10.2 million dwellings would not receive improved insulation, because they are not physically suited to individual insulation, are occupied by short-term renters, are heated by landlords, or for some other reason.

Savings Due to Added Insulation

The prospects for reducing private consumption of energy for home heating are very bright. Together, normal insulating plans and the stimulus of the proposed tax credit could result in re-insulation by 1985 for 70 percent of all owner-occupied homes built before 1975. The tax credits for renters and landlords and other programs to insulate rental housing are expected

9/ In order for a renter to benefit from the tax credit, he must (1) pay for his own heat, (2) expect to remain in his home as long as the payback period for his investment, and (3) have sufficient tax liability to claim the credit as a tax offset.

to be less successful. The energy savings attainable by re-insulating a home and making related improvements are estimated to be 35 percent of the 100 million British thermal units (BTUs) per year currently used to heat the typical home. ^{10/} An energy saving of 35 million BTUs per home annually is equivalent to about 6 barrels of oil (worth \$84 at \$14 per barrel). This saving is achieved each year after re-insulation occurs for the useful life of the dwelling. Based on the expected level of insulating activity during the life of the credit, a rising pattern of energy savings could be expected as more homes receive additional insulation.

The full energy saving resulting from additional insulation installed after the effective date of the proposed credit is equivalent to 2.9 billion barrels of oil over 27 years. The present value of this energy saving to consumers, in the form of reduced expenditures for fuel, is \$29 billion. ^{11/}

The energy saving enjoyed by individuals would exceed the cost of the improvements needed to achieve those savings, both with and without the tax credit. The benefit-cost ratio for private investments in insulation and related items is about 3:1 without the proposed credit, and about 4:1 with the credit (i.e., after costs to homeowners are reduced). In other words,

^{10/} It has been estimated that the heating requirement for a home insulated to previous standards is about 17 BTUs per square foot of living space for each degree-day of heating demand. Insulating to up-to-date standards reduces the heating requirement to 10 BTUs per degree-day. (See The Economics of Solar Home Heating, Joint Economic Committee Print, March 13, 1977, p. 31.)

^{11/} The present value calculation is the customary way to measure benefits which accrue over time. In calculating the present value of future savings, oil prices are assumed to rise at the same rate as prices generally; therefore, future returns are discounted at the real rate of return. A 2 percent real discount rate is roughly equivalent to an 8 percent discount rate with 6 percent inflation.

TABLE VII-1. ESTIMATED IMPACT OF INSULATION TAX CREDITS: 1977-1985

Calendar Year	Homes Insulated in Response to Tax Credit <u>a/</u> (in millions)	Annual Energy Saving Stimulated by Tax Credit (in millions of barrels of oil)	Credits Allowed in Following Fiscal Year <u>b/</u> (in millions)	
			1977 Dollars	Budget Dollars <u>c/</u>
	(I)	(II)	(III)	(IV)
1977	0.8	—	\$ 224	\$ 224
1978	1.4	4.2	358	379
1979	1.3	12.0	348	391
1980	1.1	19.2	345	411
1981	1.0	25.8	313	395
1982	0.9	31.8	272	364
1983	0.6	36.6	230	326
1984	0.7	40.2	209	314
1985	—	44.4	—	—
Total				
1977-1984	7.8	—	\$2,299	\$2,804

Present Value of Private Energy Saving: \$9.2 billion
(assumed 20-year life for improvement)

Present Value of Tax Expenditure (1978-1985): \$2.1 billion

SOURCE: Congressional Budget Office.

a/ The figures in Column I represent homes that would not have been improved without the credit; they do not show the total number of homes re-insulated from 1977-1984.

b/ The figures in Columns III and IV reflect the credits paid for improvements spurred by the tax credits, as well as those improvements which would have occurred anyway during the credit period.

c/ Budget dollars reflect the actual cost of the credits when paid, allowing for 6 percent inflation annually.

the fuel savings are three times the cost of insulation without the credit, and four times the cost with the credit. Thus, the credit further enhances an already profitable investment.

The proposed credit will motivate \$2.9 billion worth of home insulation that would not otherwise take place. As a consequence, private oil consumption will be reduced by 44 million barrels annually by 1985, and by 890 million barrels in total by the year 2004. Table VII-1 summarizes estimated responses to the credit and the energy saving that results.

ENERGY-SAVING IMPACT OF SOLAR EQUIPMENT TAX CREDITS

Expected Use of Solar Equipment

The potential for energy saving with the widespread use of solar equipment for residential space and water heating is immense, but so is the potential cost. Currently, equipment costs are high. Solar equipment is not expected to come into widespread use, unless fuel prices rise substantially more than is already projected, or solar equipment costs decline. Solar equipment is most attractive in new structures where savings on conventional equipment partially offset solar costs, and in areas where water is presently heated by high-cost electricity. The Administration goal of solar energy equipment in 2.5 million homes by 1985 suggests the potential for an annual saving by 1985 of 9 million barrels of oil (or equivalent) if those homes use solar power only for heating water. If some of the 2.5 million homes also use solar power for space heating, the saving would be even greater.

Administration Goal. The Administration goal of 2.5 million solar-equipped homes by 1985 seems unattainably high. Achieving that goal would require sales growth in excess of 75 percent annually or a technical breakthrough that permits even more rapid growth for the last few years of the credit. It is unlikely that a 75 percent growth rate will occur, and a technical breakthrough cannot be counted upon. Therefore, estimates reflecting a more modest (25 percent) annual growth from sales of 50,000 units in 1978 will be used for illustrative purposes.

Illustrated Response to Solar Tax Credit. In the following illustration, a number of assumptions apply. Each solar unit is assumed to save 75 percent of the energy required for domestic water heating, but none of the energy required for

TABLE VII-2. ESTIMATED IMPACT OF SOLAR TAX CREDIT: 1977-1988

Calendar Year	Solar Units Installed in Response to Tax Credits (in thousands)	Annual Energy Saving Stimulated by Tax Credit (in millions of barrels of oil)	Credits Allowed in Following Fiscal Year <u>b/</u> (in millions)	
			1977 Dollars	Budget Dollars <u>c/</u>
	(I)	(II)	(III)	(IV)
1977	8	—	\$ 10.5	\$ 10.5
1978	20	.03	26.2	28.1
1979	25	.10	32.8	36.9
1980	31	.20	31.2	37.2
1981	39	.32	39.1	49.4
1982	49	.46	39.7	53.1
1983	61	.64	49.6	70.4
1984	76	.87	62.0	93.2
1985	<u>a/</u>	1.16	—	—
Total				
1977-1984	309	—	\$291.1	\$378.8
Present Value of Private Energy Saving:			\$240 billion	
(assumed 20-year life for improvement)				
Present Value of Tax Expenditure (1978-1985):			\$262 billion	

SOURCE: Congressional Budget Office.

a/ Proposed credit expires at the end of 1984. Figures in Column I represent solar units that would not be installed without the tax credit.

b/ The figures in Columns III and IV reflect estimates (based on the CBO illustration) of credits paid for improvements spurred by the tax credits, as well as those improvements which would have occurred anyway during the credit period.

c/ Budget dollars reflect the actual cost of the credits when paid, allowing for 6 percent inflation annually.

space heating. Sales grow at a 25 percent annual rate from 50,000 units in 1978. Solar equipment has a 20-year life. Oil is worth \$14 per barrel. The average annual savings per solar installation is 3.75 barrels of oil (or its equivalent in other energy forms).

CBO's estimates for sales of solar installations due to the proposed credit, energy savings due to the credit, and credit costs are presented in Table VII-2. Not all the expected savings can be attributed to the tax credit, however. A significant number of future purchases of solar heating equipment would have occurred in some regions (based on fuel savings) even without the credit. Although the annual energy savings are small initially (30,000 barrels of oil in 1978), they rise to 1.16 million barrels of oil in 1984 as more solar equipment is installed. The energy saving to consumers from responses to the credit would amount to a present value of \$240 million. Thus, the federal government would make a present-value tax expenditure of \$262 million to 773,000 citizens. The 773,000 credit recipients would include an estimated 309,000 who would save \$240 million in fuel costs from solar equipment they would not otherwise have purchased.

Efficiency of the Tax Credits

The proposed credits for insulation and solar equipment can be evaluated from many different perspectives: (1) How much of the total credit allowance actually stimulates the desired activity and how much goes to individuals who would have made energy-saving improvements anyway? (2) How much additional investment (hence energy savings) results from the credits? (3) Are the public benefits commensurate with the costs? The focus here will be on how much additional investment is spurred by the credits and how much additional energy saving results.

It is important to specify additional investment and savings because substantial purchases of insulation and solar equipment would occur even without the credit. Rising heating costs, for instance, represent a continuing incentive for such improvements.

Insulation Credit. In the absence of the proposed tax credit, an estimated 16 million homes would receive added insulation by 1985. The primary motivation for this activity is

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are responsible. First, the credits are available only to taxpayers whose tax liabilities are sufficient to cover the credit claim. To claim a \$50 credit for insulation expenditure of \$200, a family will generally need an income of at least \$7,000. ^{14/} The maximum solar credit (\$2,000) is generally available to families with incomes in excess of \$18,000, although it is available to single taxpayers with incomes as low as \$12,000. A refundable credit, which would avoid this selectivity, was incorporated in prior proposals for insulation credits (e.g., H.R. 6860, 94th Congress).

Second, because the credits are more available to middle- and upper-income households, they tend to favor homeowners more than renters, and homeowners with significant tax liabilities more than those with little or no tax liability. (Homeowners generally have higher income levels than renters--\$13,600 vs. \$7,900 in 1975.) ^{15/} The direct grant proposals incorporated in the National Energy Plan may help some low-income families, but the grant funds requested by the Administration would cover only about 2.5 million homes. ^{16/} The proposed 10 percent insulation credit for landlords may help some tenants, but the likely landlord response is uncertain. ^{17/} With regard to the solar credit, it is unlikely that any significant number of low-income families or renters will receive any benefit.

SUPPLY CONSIDERATIONS FOR INSULATION

Production and Prices

A sudden increase in the demand for insulation and related items could raise the prices of these products. If purchases

^{14/} This figure, like the following one, is based on a family of four using the standard deduction.

^{15/} See Department of Housing and Urban Development, Annual Housing Survey, 1976.

^{16/} The National Energy Plan proposes expenditures of \$530 million over three years. (See National Energy Plan, p. 41.)

^{17/} National Energy Plan, p. 42.

are delayed because of price increases or outright shortages, achievement of the Administration's energy-saving goals could be delayed. CBO regards widespread shortages of insulation materials as unlikely--partly because not everyone will buy the various insulating materials in the early years of the credit, and partly because production capacity is already being expanded.

Both glass fiber and cellulose are widely used for home insulation. Glass fiber insulation is manufactured by three dominant firms, all of which have expanded or are expanding their plants. Manufacturing capacity is expected to double by 1980. Cellulose insulation, which is coming into increasing use, is manufactured by a large number of small companies. Cellulose insulation is made from old newspapers, which are in plentiful supply. Growing use of this product may minimize the impact of possible supply limitations for glass fiber insulation.

Storm windows and materials for caulking and weather stripping are not expected to present any particular supply-constraint problems. Storm windows are fabricated by a large number of firms serving local markets. Although little is known about the total capacity for production, supply constraints are unlikely to bind, because storm windows are generally given a lower priority than insulation. The saving per dollar spent for added insulation generally exceeds that attainable from adding storm windows.

Prices for insulation products have gone up recently--even before the credit was proposed. The wholesale price index for insulating materials rose by about 55 percent between 1973 and 1976, compared to a 36 percent increase for all items. As the demand for insulation expands, insulation prices may increase still further. Some experts suggest that the windfall portion of the credits to buyers who planned to insulate anyway will only compensate those buyers for the cost increase resulting from announcement of the credit.

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either to return revenues to the economy or to induce energy conservation or industrial conversion to coal. The net effect of the tax programs is an increase in revenues for each year between 1979 and 1985. Nontax effects include direct federal expenditures and receipts from energy-related sales, leases, and royalties.

Tax effects result from four types of provisions. The first--represented by the gas-guzzler tax, the crude oil equalization tax, and the standby gasoline tax--is designed to rebate all taxes collected, which would yield no net effect on the budget. These provisions are designed primarily to alter the structure of costs associated with inefficient uses of energy or to force the conversion to coal. A second type of tax provision is designed to induce energy conservation; these include tax expenditures for commercial and residential improvements or such tax reductions as the repeal of excise taxes on inter-city buses. In general, these provisions reduce revenues to the U.S. Treasury. A third type of tax provision is planned to increase the price of energy without a rebate; among these proposals are the motorboat and airplane fuel taxes. Finally, there are taxes related to inducing coal use, which generate net revenues only if firms do not convert. The estimates for these various tax provisions are presented in Table VIII-1. (The estimates are derived mostly from the analysis in previous chapters; other estimates were provided by the Office of Management and Budget.)

Effects on Expenditures

Six features in the National Energy Plan would contribute to direct federal expenditures:

- o Expanded and accelerated Strategic Petroleum Reserve Program,
- o New programs to improve the energy efficiency of federal buildings, residences of low-income families, schools, and hospitals,
- o Changes in federal energy research and development programs,
- o Reduced sales of petroleum products from the Naval Petroleum Reserves,

TABLE VIII-1. PROJECTED TAX GAINS AND LOSSES: IN MILLIONS OF CURRENT DOLLARS, BY FISCAL YEARS

	1978	1980	1985
Tax Expenditures			
Thermal efficiency credit--residential <u>a/</u> (Insulation Tax Credits)	-224	-391	-314
Thermal efficiency credit--industrial <u>b/</u> and commercial	-306	-349	--
Cogeneration credit <u>b/</u>	-52	-106	--
Solar equipment credit--residential <u>a/</u>	-11	-37	-93
Expense geothermal intangible drilling <u>b/</u> costs	-5	-17	-54
Restricting minimum tax on intangible <u>b/</u> drilling cost	-19	-37	-74
-SUBTOTAL	-617	-937	-535
Other Revenue Losing Provisions			
Repeal of excise tax on intercity buses <u>b/</u>	-13	-9	-9
SUBTOTAL (TAX EXPENDITURES & OTHER LOSSES)	-630	-946	-544
Revenue-Gaining Provisions			
Motorboat and airplane fuels tax <u>b/</u>	45	54	80
Coal conversion incentives industrial <u>c/</u> taxes: Revenues -	--	9,758	19,398
Rebates	--	-5,831	-11,607
Coal conversion incentives utility <u>c/</u> taxes net of rebate	--	--	101
Crude Oil Equalization Tax: <u>d/</u>			
Revenue	--	18,800	17,967
Rebates	--	-18,800	-17,967
SUBTOTAL (REVENUE GAINS)	45	3,981	7,972
TOTAL TAX EFFECTS	-585	3,035	7,428

a/ See Chapter VII.b/ These provisions are detailed in the National Energy Act, Title II. The data were provided by the Office of Management and Budget.c/ See Chapter V.d/ See Chapter III.

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The National Energy Plan calls for existing federal facilities to reduce their energy consumption by 20 percent from 1975 levels, and for 45 percent greater energy efficiency in new federal buildings. Because new construction proceeds at a rate of only 20 million square feet per year (adding 1.25 percent to existing federal space), the budgetary impact of the 45 percent reduction would be insignificant in the early years of the program. An approximation of the necessary funding level needed to achieve a 20 percent reduction of energy use in existing facilities can be derived by using the Department of Defense (DoD) energy conservation program as a base. Using DoD's six-year "retrofitting" program as a model, it is estimated that the average annual costs would be approximately \$250 million for all federal buildings.

The National Energy Act proposes a corollary program to install solar demonstration facilities in federal buildings, which would add \$37 million in budget authority for the Federal Energy Administration in fiscal year 1978, \$32 million in fiscal year 1979, and \$31 million in fiscal year 1980 for a cumulative funding level of \$100 million. 1/

The projected decrease in federal consumption of fuel would somewhat offset the higher costs anticipated as a result of fuel tax provisions in the act. The federal government spent approximately \$4 billion in fuel for facilities and transportation in fiscal year 1976. Without the plan, it is assumed that federal consumption would remain constant through 1985 while fuel prices would rise by about 5.5 percent a year. The cumulative fuel bill between fiscal years 1978 and 1985 would therefore be \$44 billion. If the fuel tax provisions are instituted, fuel prices will increase at higher rates (assuming an average annual increase of 10 percent in all fuel categories), but the cost to the government would be offset by a 2 percent reduction in federal consumption each year. Under the plan, therefore, the federal fuel bill through fiscal year 1985 would be \$48 billion, or \$4 billion higher than without the plan.

1/ These projections are based on present policy. If the proposal now before the Congress to merge federal energy-related agencies is adopted, the projections concerning the FEA, ERDA etc. would change.

The effect of the proposals on the research program conducted by the Energy Research and Development Administration (ERDA) would be a net reduction of \$455.1 million in budget authority and \$116 million in outlays for fiscal year 1978. This reduction would result from cancelling construction of the gaseous diffusion uranium enrichment plant in Portsmouth, Ohio, and the construction-related components of the Clinch River Liquified Metal Fast Breeder Reactor. These two decisions would result in reduced budget authority requests of \$512 million and \$173 million, respectively. An additional \$61.4 million would be saved through the elimination of research and development programs on fuel cycle technologies for light water reactors and uranium process development associated with gaseous diffusion technology. These reductions would be offset by an additional \$111.3 million in budget authority in fiscal year 1978 to expand research in the areas of fossil, geothermal and solar energy, and nuclear nonproliferation.

The energy plan also calls for increased emphasis on the construction of a gaseous centrifuge plant for uranium enrichment, which will increase the budget authority for ERDA for fiscal year 1978 by \$180 million. The cumulative project cost is not considered an additional cost element of the plan, however, because the centrifuge plant has already been included in ERDA budget projections. The primary effect of shifting the research and development effort away from nuclear energy to other energy sources, would be a substantial reduction in budget authority and outlays in the years discussed.

The Administration's proposed legislation would authorize development of energy efficiency standards for buildings and appliances, as well as for the development of home conservation plans by public utilities, and the establishment of a federal "vanpooling" program. (Vanpooling is a form of carpooling designed to reduce the number of vehicles the federal government uses.) The legislation would authorize \$10 million in fiscal years 1978 and 1979 for the building standards program. But it does not specify authorization levels for the appliance standards, utility plans, or vanpooling programs; however, estimates of these program costs in fiscal year 1978 are \$12.5 million, \$12.7 million, and \$12.5 million, respectively. The vanpooling program, which would ultimately be reimbursed through passenger fares, would nevertheless incur net outlays until the program is fully underway. The cumulative costs of these proposed programs through fiscal year 1985 (excluding the vanpooling program) are \$129 million.

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TABLE IX-1. PROJECTED FOSSIL FUEL PRICES a/

Fuel	Total Fuel Bill, 1976 (billions of dollars)	Price Indexes, 1976 = 1.0			
		1977	1978	1979	1980
Domestic Crude Oil					
Baseline	31.3	1.033	1.189	1.320	1.461
Carter		1.042	1.391	1.703	1.970
Imported Crude Oil					
Baseline	35.9	1.090	1.150	1.213	1.280
Carter		1.090	1.155	1.241	1.325
Natural Gas					
Baseline	12.5	1.341	1.758	1.943	2.311
Carter		1.341	1.725	2.107	2.652
Coal					
Baseline	9.8	1.078	1.163	1.254	1.352
Carter		1.078	1.174	1.272	1.377
Total					
Baseline	89.5	1.104	1.250	1.357	1.495
Carter		1.107	1.319	1.527	1.742

SOURCE: Congressional Budget Office.

a/ Prices are measured before transportation, refining, or other processing, but include excise and user taxes.

overall price level (before any amplification due to wage-price interaction). But this projected fuel price rise would by no means be all due to the Administration's proposals. Some would be due to general inflation and some to fuel market developments that would take place without the program. Without the Administration's proposals, it is estimated that fuel prices would rise by about 49.5 percent from 1976 to 1980, which translates to 2.5 percent in the overall price level before wage-price amplifications.

The differential increase in the general price level due to the President's proposals is thus only 3.7 minus 2.5 or 1.2 percent. Allowing for wage-price interactions raises this figure to 1.6 percent. Since this difference develops over the three-year span 1977-1980, it raises the annual rate of inflation during those years by 0.5 percentage points.

Output and unemployment effects are much more difficult to estimate than inflation effects. Calculations based on a number of models of the economy suggest that a 10 percent increase in the price level due to change in the price of a basic input commodity causes a drop somewhat smaller than 10 percent in total output. On this basis, the 1.6 percent price increase due to higher fossil fuel prices would decrease output by less than 1.6 percent. Rebates of the taxes collected under the oil excise and some other proposals would cut this output impact substantially, without adding much to the inflation projections during 1977-1980. Together, the price increases and rebates would reduce real output by an estimated 0.7 percent by 1980. If other provisions stimulated investment in new technologies, the reduction in real output could be even smaller.

As for unemployment, a rule of thumb is that, in the short run, a 1 percent reduction in output translates into a one-third percentage point increase in the unemployment rate. The energy proposals on this basis could add about 0.2 percentage points to the unemployment rate by the end of 1980.

From the macroeconomic point of view, the energy proposals invite comparisons with a major economic shock of recent years--namely, the OPEC quadrupling of oil prices in 1973-1974. The following figure, showing an index of fossil fuel prices (1976 = 1.0) from 1970 to 1980, is helpful in making the comparison. The Administration's energy proposals would add 0.25 points (the

Index of Fossil Fuel Prices^{a/} 1970-1980
(1976 = 1.0)

^{a/} Price index includes imported and domestic crude oil, natural gas, and coal. Prices are inclusive of the proposed excise and user taxes but exclusive of transportation, refining, or other processing costs.

Source: Congressional Budget Office.

difference between the solid and dashed lines in 1980) to the price index of commodities worth \$90 billion in 1976. They thus add roughly 0.25 times \$90 billion, or \$22 billion to our national fuel bill (in 1976 prices), and do so gradually over a period of three years. The OPEC increase added 0.40 points to the price index, or a bill of \$36 billion (in 1976 prices), and did so all at once rather than over several years. Clearly, the OPEC increase was a much larger shock than the energy proposals. Immediate decontrol of "old" oil, had it taken place during 1975, would also have been a much larger shock than the energy proposals.

The remainder of this chapter deals with the short-run macroeconomic impacts of the President's proposals in greater detail. The price effect of the proposals will be discussed first, with the output and employment effects following.

PRICES

The central energy proposals which would directly raise prices are:

- o The excise tax on domestic crude oil to be introduced in stages beginning late in 1977;
- o The high price permitted on newly discovered oil;
- o Removal of the present ceiling on gasoline prices; and
- o The tax on industrial use of gas and oil beginning in 1979.

Two provisions that could raise prices under some circumstances, but that are not expected to do so during 1977-1980, are:

- o The increase of the ceiling price on interstate natural gas, which is offset by the reduction in intrastate natural gas prices;
- o The standby tax on gasoline to be imposed if gasoline consumption exceeds a target path, which is estimated not to be triggered before 1981.

In addition, other parts of the program could affect prices. Requirements for use of coal by utilities and industry could lead to more expensive technologies that, in turn, could be passed along in the form of higher prices. Subsidies for insulation, solar heating, and other energy-conserving measures could increase the demand for some kinds of output and raise their prices. The assumption underlying this analysis is that these more conjectural price effects are small enough to be neglected in an overall analysis. The price effects of the proposed gas-guzzler tax, which raises the price to consumers of some cars and lowers the price of others, are also neglected in this macroeconomic analysis. Finally, the analysis assumes that the standby tax on gasoline will not be triggered until after 1980. (For discussion of these last two points, see Chapter VI.)

The effects of the program on final demand also have price consequences. As discussed below, there are reasons for believing that price-raising features of the program would tend to depress final demands, while the proposed rebates would add to final demands. It is estimated that these offsetting influences on final demands net out to a fairly small impact and one which would have a scarcely measurable effect on inflation rates through 1980.

It is helpful to think of the price effects of the energy program in three stages, although in fact the three stages may overlap. In the first stage, the proposed taxes and other measures directly affect fuel prices, with consumers feeling the impact only to the extent that they purchase fuels--for example, gasoline--directly. In the second stage, increased fuel costs for producing many thousands of goods and services are reflected in higher final product prices. In the third, and most conjectural stage, higher consumer prices affect wage negotiations and price expectations generally and become magnified through a price-wage spiral.

To analyze this complex process, it is necessary to use econometric models of the economy. The results of such models are subject to wide margins of uncertainty, but they are the most complete way of taking account of a whole set of complex economic forces and their interactions. To minimize the uncertainty involved, the analysis below is based on several different models.

As Table IX-2 shows, the most immediate and largest price impact of the program is estimated to be at the wholesale level. Wholesale fuel prices could increase by an estimated 5.5 percent in 1978, an additional 7 percent in 1979, and by 4 percent more in 1980, so that by the end of the period they would be 16.5 percent higher than they would otherwise be. The overall Wholesale Price Index, mainly reflecting this fuel increase, goes up by 3.1 percent from 1977 to 1980 as a result of the energy package.

TABLE IX-2. IMPACT OF THE ENERGY PROPOSALS ON PRICES AND WAGES
(Percent Difference from Baseline Price Projections)

Prices and Wages	1977	1978	1979	1980
Wholesale Prices				
Fuels	0.3	5.5	12.5	16.5
Total	0.1	1.3	2.8	3.1
Consumer Prices	0.0	0.5	1.1	1.6
Average Hourly Wages	0.0	0.2	0.4	0.7

SOURCE: Congressional Budget Office.

At the consumer level, effects build more gradually. From 1977 to 1978, the calculated increase would be only 0.5 percent. In 1979 and 1980, the increase would be somewhat larger so that the three-year increase is 1.6 percent, or an average of just over 0.5 percent per year. The consumer increase reflects partly the transmission of higher wholesale costs to the retail level, but it also reflects the effect of the program on wage negotiations and, subsequently, second-round price adjustments. According to the models, by 1980 average hourly wages would be 0.7 percent higher with the energy proposals than without them.

What the models suggest, in short, is that the energy proposals would add 1.6 percent to the 1980 consumer price

level, or about 0.5 percentage points per year to the rate of inflation during 1977-1980. If the underlying rate of inflation without the program were 5 percent enactment of the program would raise the rate to 5.5 percent. To put this number in perspective, it may be useful to compare it to some recent rates of inflation. In 1974, the Consumer Price Index was 11 percent higher than a year earlier. Rates of increase in the two subsequent years were 9.1 and 5.7 percent. Thus, the 0.5 percent per year that the energy proposals are estimated to add to the rate of inflation, while measurable and significant, is not large in relation to the underlying rate or its changes in recent years.

OUTPUT AND EMPLOYMENT

There are three reasons for thinking that the price-raising portions of the energy package might depress constant-dollar spending on goods and services and hence exert a negative influence on output and employment. The first is that higher prices reduce the real value, or purchasing power, of many forms of wealth, such as money, savings accounts, insurance policies, and pension rights. This decrease in purchasing power, in turn, could reduce real expenditures on consumer goods. The second channel of influence is the effect of higher prices on interest rates. Fuel price increases tend to raise inflation rates and current-dollar incomes (even though they depress real incomes). If these changes are not offset by a more expansionary monetary policy, they tend to raise interest rates, which in turn depress investment and possibly other final demands. The third channel of effect is the redistribution of income away from households and toward government and businesses. To the extent that these transfers occur, they could cause a temporary rise--in all likelihood not a permanent one--in the national saving rate.

To offset this third channel of influence, the energy proposals include full rebates to households of the proceeds of the oil excise tax and the standby gasoline tax (if it comes into play) and a partial rebate to business of the oil and gas user tax. These rebates, by adding to purchasing power in the hands of consumers and businesses, would tend to offset the drop in private purchasing power caused by the price-increasing features of the energy program.

Other portions of the program could also affect final demand. Subsidies to certain kinds of conservation expenditures could well increase demands for those goods and could possibly increase overall demands. Creation of a national petroleum reserve, while it is being built up, would have a direct impact on demand for petroleum. Requirements for conversion from oil and gas use to coal use would affect the composition of investment and could affect its overall level.

Once again it is necessary to use econometric models to analyze the net effect of all of these provisions on output and employment. The results in Table IX-3 are based on the calculated effects of the price-raising measures and the rebates, assuming that the rebates are paid out at the same time that the revenues are collected. The calculated effects assume a zero net impact of the other provisions on investment. For this reason, the numbers in Table IX-3 might be considered to be upper-limit estimates of the reduction in output and the increase in unemployment that the energy proposals could cause.

TABLE IX-3. IMPACT OF THE ENERGY PROPOSALS ON OUTPUT AND EMPLOYMENT (Percent Difference from Baseline Projections)

Economic Variables	1977	1978	1979	1980
Real GNP and Components (Constant Dollars)	0.0	-0.2	-0.5	-0.7
Consumption Expenditures (Constant Dollars)	0.0	-0.1	-0.3	-0.4
Fixed Investment Expenditures (Constant Dollars)	0.0	-0.4	-1.2	-1.8
Unemployment Rate <u>a/</u>	0.0	0.0	+0.1	+0.2

SOURCE: Congressional Budget Office.

a/ Differences from baseline in percentage points.

Output and employment effects, even those in Table IX-3, are estimated to be fairly small. At the end of three years, the program is estimated to reduce output by approximately \$10 billion in 1972 dollars, or 0.7 percent of real GNP. This amounts to about \$14 billion in 1977 dollars. The unemployment rate, as calculated, would be about 0.2 percentage points higher under the energy program by the end of 1980 than it would otherwise be. Since these effects build up over three years, they must be considered to be fairly small compared to other influences on the course of macroeconomic activity. The unemployment effect, for example, is equivalent to an acceleration in the rate of growth of the labor force of approximately seventy thousand persons per year, which is only a small increase above its projected year-to-year growth of approximately two million persons.

Macroeconomic effects could be smaller than the amounts indicated in Table IX-3 if some of the investment incentives and conversion requirements proposed have a sizable stimulative effect on investment or government purchases. A spending impact, growing to approximately \$7 billion by 1980, would serve to offset completely the output and unemployment effects indicated in Table IX-3.

In summary, the impact on output and employment of the proposed energy program appears likely to be negative but of small size. If the energy program is enacted, the economic outlook for the next two or three years may be a shade worse than it would have been in the absence of the program, and these energy effects will be one among many factors that policymakers will wish to take into account in setting overall monetary and fiscal policies for the years ahead.

CHAPTER X. THE DISTRIBUTIONAL IMPACT OF THE ENERGY PROPOSALS

Several parts of the Administration's energy program are designed to change the energy-using habits of Americans by raising the relative cost of those goods and services that use scarce energy resources lavishly. At the same time, the program seeks to maintain the overall purchasing power of consumers by providing benefits that help to replace the losses stemming from higher prices. A system of taxes, efficiency standards, tax credits, and cash rebates has been proposed to induce both the desired changes in prices and in energy consumption and to provide compensatory benefits for the costs that will be imposed.

Although the income taken away by the higher prices of energy-intensive products is to be refunded, partly in the form of cash rebates, it is not expected that these refunds will simply be used to pay the higher energy prices. Because a dollar of income will buy relatively more of the energy-saving goods and less of the energy-intensive goods than before, it is anticipated that consumers will have a strong incentive to buy less energy-intensive goods with their cash rebates. In addition, some of the rebates can be obtained only by purchasing low energy-using products, as in the case of the rebate for purchasing gasoline-efficient autos.

Although the Administration's program is designed to replace the aggregate income lost through higher prices, the income losses and rebates implicit in the program can have very different impacts on individual consumers. The cost of auto travel, of new energy-inefficient cars, and of other goods and services that rely on oil or gasoline as inputs will rise relatively sharply. These price increases are likely to impose different burdens on different people. The proposed per capita rebates of oil and gasoline taxes, the rebates associated with new energy-efficient cars, and the tax credits for insulation and other energy-conserving expenditures for the home will provide benefits that may not be related to the individual burdens imposed. Whether, on balance, the distribution of those costs and benefits is perceived as being fair, however, is likely to be an important determinant of the political viability of the proposals.

This chapter contains a discussion of the conceptual and practical problems encountered in defining and implementing a

fair energy policy as well as a description of the likely effects that the Administration's proposals will have on families differing by income class and by place of residence.

THE CONCEPTUAL PROBLEM

While we may all believe in the principle of fairness, it is a difficult concept to define precisely or to put into practice with respect to energy policy. Generally, a policy is thought to be fair if the burdens imposed by that policy are related to the ability of individuals to bear those burdens.

The Administration's energy proposals will deliberately raise the price of commodities essential to modern American life-styles--gasoline and other products dependent on oil. Those who consume relatively few of the goods and services that are to rise in price will have minimal costs imposed on them. Those who consume relatively more of these products will be faced with the possibility of large losses in the purchasing power of their incomes. For example, if owners of fuel-inefficient cars were to persist in driving the same cars the same number of miles as before, they would have to give up substantial amounts of other goods and services to do so. Most people will, however, adjust their behavior somewhat by reducing their consumption of the goods and services that rise in price and substituting the use of cheaper products.

Not everyone has the same opportunities, or willingness, to make these substitutions. Some have ready access to car pools or mass transportation; others would make nontransportation substitutions, for example, playing tennis instead of taking a Sunday drive.

An ideal system of offsets would involve a separate evaluation of each family's preprogram energy use and the opportunities available to it to conserve. The offset from the federal government would then be tailored to equalize the excess burden or income loss imposed by higher energy prices after the family had made "reasonable" substitutions. Of course, in practice, only much cruder methods for moderating inequities are available.

The burden of an increase in prices for energy-intensive products will vary from group to group. Some of these variations may be traced to a few general characteristics, such as family

size, climate, and location. Consumption of energy-intensive products is likely to rise with family size. People living in warmer climates will be less affected by a rise in the price of home heating fuel. People living in cities with good public transit systems are likely to find it easier to reduce work trips by car. People using their cars mostly for commuting to work may find it more difficult to cut back on gasoline consumption.

The Administration's energy proposals offer various mechanisms for offsetting the burden imposed by increased energy prices. These include per capita credits and payments that will refund much of the money collected through the crude oil equalization and the standby gasoline taxes, rebates that will distribute the proceeds of the gas-guzzler tax to purchasers of energy-efficient cars, and refunds to suppliers of home heating oil that will keep the price to consumers from reflecting the crude oil equalization tax. These instruments implicitly make some rough adjustments to mitigate the burdens imposed by the price increases. Since the proposed rebates will be applied on a per capita basis, there is an implicit adjustment for the effect family size may have on energy consumption. Because of subsidies to keep down the price of home heating oil, there is an adjustment for regional impact (cold versus warm places) that the crude oil equalization tax would have had on those who heat with oil. Nevertheless, it is clear that, because of individual differences, the Administration's energy policy will compensate some families in excess of the added cost and will compensate others less than the added cost of the program.

The remainder of this chapter looks at the likely impact of the costs of the program on families differing by income and other characteristics. The extent to which the rebates mitigate the differential cost effect is also examined.

THE DISTRIBUTIONAL IMPACT OF RISING ENERGY PRICES

The Administration's energy proposals will cause prices of different types of energy and energy-using products to rise at different rates. The reliance of different income classes and regions on the various types of energy and products varies considerably. This section summarizes what is known about the possible distributional impacts of the major elements of the Administration's energy proposals affecting prices, particularly those elements that would increase gasoline prices.

Increased Gasoline Prices

The imposition of the crude oil equalization tax and the standby gasoline tax will cause a substantial rise in gasoline prices. CBO estimates that by 1980 the equalization tax will increase the price of gasoline by 3.5 cents per gallon (in 1977 prices). The standby gasoline tax is not expected to be triggered until at least 1982. By 1985, it is estimated to add an additional 12 cents per gallon (in 1977 prices) to the price of gasoline.

The initial burden imposed by these price increases will vary according to gasoline usage. On average, gasoline consumption increases with family income (see Table X-1). This reflects the fact that higher-income persons tend to have more cars per family, that they drive each car more miles, and (according to some evidence) that their cars tend to be less energy efficient --that is, they get fewer miles per gallon than cars owned by lower-income families (see Table X-2). ^{1/}

TABLE X-1. ANNUAL EXPENDITURES PER FAMILY ON GASOLINE, BY FIFTHS OF FAMILIES RANKED BY MONEY INCOME, 1973-1974

Families Ranked by Money Income ^{a/}	Average Annual Gasoline Expenditures		Average Annual Gasoline Expenditures, Families With Vehicles Only		Percent of Families Owning One or More Vehicles
	Dollars	Percent of Income	Dollars	Percent of Income	
Lowest Fifth	139	6.6	311	14.8	44.7
Second Fifth	290	5.2	383	6.9	75.8
Third Fifth	419	4.5	473	5.1	88.6
Fourth Fifth	497	3.6	522	3.8	95.2
Highest Fifth	605	2.5	624	2.6	97.0

SOURCE: Calculated by CBO based on data from the Consumer Expenditure Survey Series: Diary Survey, July 1973-June 1974, U.S. Department of Labor, Bureau of Labor Statistics, Report 448-3.

^{a/} In 1973-1974, the income ranges for each fifth were: lowest fifth-under \$3,800; second fifth-\$3,800 to \$7,456; third fifth-\$7,457 to \$11,198; fourth fifth-\$11,199 to \$17,010; highest fifth-\$17,011 and over.

^{1/} Evidence on the relative fuel efficiency of cars owned by high- and low-income families is contradictory. In any case, the improvements in auto efficiency expected over the next ten years benefit high-income families first.

TABLE X-2. FACTORS RELATED TO GASOLINE USE, FAMILIES CLASSIFIED BY INCOME, 1972-1973, IN PERCENTS a/

Factor	Income Class of Family or Car Owner b/			
	Poor	Lower-Middle	Upper-Middle	Well-off
Cars				
No cars	47	16	4	1
1	37	52	35	21
2	14	25	51	58
3 or more	2	7	10	21
All cars	100	100	100	100
Miles driven in past years c/				
Less than 10,000	64	39	15	12
10,000 to 14,999	17	27	18	15
15,000 or more	20	35	67	72
All cars	100	100	100	100
MPG (Locally)				
0-14 mpg	31	50	54	62
15-19	47	32	30	24
20 and over	22	17	16	14
All cars	100	100	100	100
MPG (Long distance)				
0-14 mpg	22	23	32	34
15-19	46	49	46	44
20 and over	32	29	22	22
All cars	100	100	100	100

SOURCE: Dorothy K. Newman and Dawn Day, The American Energy Consumer, a report to the Energy Policy Project of the Ford Foundation, 1975.

a/ Percents may not add to 100 due to rounding.

b/ Income in 1972. The average income of the poor as defined by the study was \$2,500; for the lower-middle, \$8,000; for the upper-middle, \$14,000; for the well-off, \$24,500. The classification of poor takes family size into account.

c/ Cars owned 12 months or more for which mileage was reported.

Car use varies by income in part because of differences in the age, work participation, and other characteristics of people at different income levels. According to one survey, commuting to work accounts for more than 40 percent of all car miles traveled. ^{2/} About three-quarters of all workers go to work by car. Families at the lowest-income levels, however, are much less likely to be composed of workers since they tend to be headed by older or retired people or by women with young children. ^{3/} By contrast, families in higher-income categories often have at least two earners. If one considers only heads of families who are working, however, there is not much difference in the means of transportation to work by income group. In the poorest-income fifth, 84 percent go to work by car and among the richest fifth, 91 percent do so. The difference is made up by a larger proportion of walkers and bicycle riders among the poorest fifth. Only 8 percent of the employed household heads (whether poor or rich) use public transportation to go to work ^{4/}.

While gasoline consumption does tend to increase with income, it does so less than proportionately. Thus, families in the lowest fifth of the income distribution in 1973-1974 spent an average of \$139 on gasoline during the year and families in the highest fifth spent \$605. This expenditure represented 6.6 percent of the income of the lowest fifth but only 2.5 percent of the income of the highest fifth (see Table X-1). If low-income families find it no easier than high-income families to reduce their consumption of gasoline, then the

^{2/} U.S. Department of Transportation, Federal Highway Administration, Household Travel in the United States, Report #7, December 1972.

^{3/} In 1973, among families in the lowest fifth, close to 50 percent were headed by a person who was out of the labor force and 39 percent had no family members in the labor force at all. Among families in the highest fifth, 97 percent were headed by a person in the labor force, 45 percent had two earners, and 31 percent had three earners or more. (U.S. Bureau of the Census, 1973 Current Population Report, Series P-60, #97.)

^{4/} Dorothy K. Newman and Dawn Day, The American Energy Consumer, a report to the Energy Policy Project of the Ford Foundation, 1975.

burden of an increase in gasoline prices will be regressive; that is, the increase will have a relatively larger impact on those with lower incomes than on those with higher incomes.

While there is clear evidence that average gasoline consumption varies by income group, there is also evidence that there is a great deal of variation within each group. While virtually all upper-income families own cars, a substantial portion of lower-income people do not. In 1973-1974, about 55 percent of families in the lowest-income fifth did not own a car and therefore were hardly affected by increased gasoline prices. Thus, the absolute and relative burden placed on those lower-income families who do own cars would be substantially greater than the average. As indicated in Table X-1, those families in the lowest-income fifth who did own cars spent close to 15 percent of their incomes on gasoline, compared to the average of 7 percent for all families at that income.

Greater detail about the distribution of the relative burden of gasoline expenditures is given in the estimates of Table X-3. It appears that there is considerable dispersion in the relative burden of gasoline expenditures within an income class, but that

TABLE X-3. PROPORTION OF INCOME SPENT ON GASOLINE, BY TENTHS OF FAMILIES RANKED BY MONEY INCOME, 1974

Family Income by Tenths	Fuel Cost as Percent of Family Money Income							NA	Total
	No Car Zero Percent	0-5 Percent	5-10 Percent	10-15 Percent	15-20 Percent	20 Percent			
(Distribution of Families)									
Lowest	57.8	14.7	6.2	5.4	2.8	6.0	7.0	100.0	
Second	38.2	31.6	11.6	5.8	2.5	5.9	4.2	100.0	
Third	23.2	34.3	21.3	8.7	2.8	3.7	6.0	100.0	
Fourth	13.0	44.8	27.1	7.2	2.2	2.5	3.1	100.0	
Fifth	10.3	48.2	29.8	6.2	1.8	1.6	2.1	100.0	
Sixth	4.6	60.2	24.4	7.1	1.0	0.8	2.1	100.0	
Seventh	3.4	64.4	23.8	5.6	0.6	0.3	1.9	100.0	
Eighth	3.2	68.5	22.5	2.9	0.0	0.0	2.9	100.0	
Ninth	0.6	80.1	13.0	2.0	0.2	0.4	3.7	100.0	
Highest	0.7	88.3	8.0	0.4	0.0	0.0	2.6	100.0	

SOURCE: John Holmes and James Morgan, The Impact of Rising Gasoline Prices: Some National Survey Data, Survey Research Center, University of Michigan, February 1975.

the dispersion narrows as income rises. Thus, among families in the lowest-income tenth, 58 percent spent nothing on gasoline in 1974, while 6 percent spent more than 20 percent of their income on gasoline. As income rises and car ownership becomes almost universal, the percentage of income spent on gasoline tends to concentrate in the 0-5 percent range. Among those in the highest tenth, 88 percent are in that range; in that group, however, about 8 percent spend more than 5 percent (a very large absolute expenditure) of their income on gasoline.

The impact of higher gasoline prices will differ significantly by region as well as income class. As indicated in Table X-4, families in the lowest-income fifth living in the South spent 57 percent more on gasoline than those living in the Northeast in 1973-1974. In general, within an income class, more is spent on gasoline in the South and West and less in the Northeast, but the regional differences are smaller at the highest-income levels.

TABLE X-4. REGIONAL DIFFERENCES IN ANNUAL EXPENDITURES ON GASOLINE FOR FAMILIES RANKED BY MONEY INCOME, 1973-1974

Family Ranked by Money Income <u>a/</u>	Annual Expenditures Per Family On Gasoline					
	North- east	North Central	South	West	Rural	Inside SMSAs <u>b/</u>
Lowest Fifth	102	132	160	146	208	124
Second Fifth	226	301	306	318	387	259
Third Fifth	346	415	475	421	529	407
Fourth Fifth	440	483	548	523	587	487
Highest Fifth	580	615	609	625	663	601

SOURCE: Calculated from the Consumer Expenditure Survey Series: Diary Survey, July 1973-June 1974, U.S. Department of Labor, Bureau of Labor Statistics, Report 448-3.

a/ See Table X-1 for income boundaries of each fifth.

b/ Standard Metropolitan Statistical Areas.

Regional differences partly reflect differences in the percentage of families who live in rural areas. As also shown in Table X-4, families who live in rural areas spend considerably more on gasoline than those living within metropolitan areas--even at the same income level. Other data suggest that there are differences in automobile use within metropolitan areas. As one would expect, those living in the suburban ring of a metropolitan area own more cars than those with the same income living in central cities. Car ownership has been found to be greater in the newer large cities (such as Los Angeles) than in the older large cities (such as Philadelphia). ^{5/} The new cities have grown up after the advent of the automobile and reflect that development in terms of lower density and lack of public transportation. Since old cities are clustered in the Northeast, this may help explain the relatively low usage of gasoline there. Of course, income, region, city size, and age of city are not independent characteristics. They overlap, and a detailed analysis would be needed to determine the net effect of each factor.

Data are not readily available to determine how different families would or could adjust to higher gasoline prices. One possible indicator is the extent to which driving is related to commuting to work. Presumably, in the short run, it is more difficult to change this type of automobile use. As indicated in Table X-5, the proportion of total miles spent driving to work is very small (less than 10 percent) for most low-income families, although a small percentage do use their cars heavily for commuting. Among families above the median income, about 20 percent generate more than 50 percent of their total mileage commuting to work.

Some auto commuters do have access to public transportation. One study estimated that, among employed household heads living in central cities of metropolitan areas, 24 percent could switch from private to public modes to get to work without incurring any additional commuter time. ^{6/} It would be possible for another 54 percent of the central city dwellers to switch to public transit,

^{5/} See J.B. Lansing and G. Hendricks, Automobile Ownership and Residential Density, Institution for Social Research, June 1967.

^{6/} Dorothy K. Newman and Dawn Day, The American Energy Consumer, a report to the Energy Policy Project of the Ford Foundation, 1975.

TABLE X-5. VARIATION BY INCOME TENTHS IN THE RATIO OF COMMUTING MILES TO TOTAL MILES DRIVEN ^{a/}, FAMILIES WITH CARS, 1974

Family Income by Tenths	<u>Commuting Miles as a Percent of Total Miles</u>					Total
	0-10	10-20	20-30	30-50	More Than 50	
	(Distribution of Families)					
Lowest	87.0	3.6	2.1	1.4	5.7	100.0
Second	74.8	7.9	3.1	4.8	9.5	100.0
Third	59.6	6.3	8.5	8.9	16.5	100.0
Fourth	51.8	11.3	7.4	11.5	17.9	100.0
Fifth	51.6	11.7	10.3	9.9	16.6	100.0
Sixth	38.5	13.6	11.5	15.7	20.6	100.0
Seventh	33.6	14.9	14.2	15.3	21.9	100.0
Eighth	30.0	15.1	14.9	15.0	25.2	100.0
Ninth	31.6	15.4	12.0	15.1	26.0	100.0
Highest	37.4	14.2	16.2	15.7	16.7	100.0

SOURCE: Calculated from The Impact of Rising Gasoline Prices: Some National Survey Data, John Holmes and James Morgan, Survey Research Center, University of Michigan, February 1975.

^{a/} Refers to commuting miles of head of household and, where applicable, of wife who drives to work.

but it would greatly increase their commuting time. Altogether, about 90 percent have some access to public transit, including the 13 percent who now use it. For those working heads of households who live in the ring of a metropolitan area, the prospects for public transit are lower--only 56 percent have any access to public transit, including the 8 percent who already use it. Public transit is virtually unavailable to workers in rural areas and small urban areas. In the largest cities, many downtown-oriented public transit systems operate at or close to capacity during commuting hours and thus are not capable of absorbing a great influx of commuters without further incentives to expand capacity. Systems oriented toward suburban employment tend to be less capacity-bound, but service of this sort is costly to provide and often inadequate in route coverage and schedule frequency.

Further, many areas have no public transit systems, or have inadequate ones, so the above-mentioned conclusions may not hold everywhere. Thus, while many workers have some access to public transportation, it is not clear that there is a substantial number of nonusers for whom sufficiently convenient public transport alternatives are available. ^{7/}

^{7/} From an energy conservation perspective, the concern about public transport is often overstated. While well-utilized bus services have been found to be less energy-intensive per passenger mile than cars, the evidence on fixed rail systems is less encouraging. For example, Charles Lave has estimated that, because of the extra energy needed to build San Francisco's BART rail system relative to its equivalent in highways, it would take over 160 years for the savings in operating energy to break even, even if ridership doubled and the proportion of riders diverted from the auto tripled. ("Negative Energy Impact of Modern Rail Transit Systems," *Science*, Feb. 11, 1977, pp. 595-596.) Similarly, an analysis of Philadelphia's Lindenwold Line found that, because many of the rail system's patrons were former bus passengers and because they made circuitous routing (often by automobile) in order to use the system, an average trip after the system was built used more energy than it had before the system was operating. (David E. Boyce, et. al., "Impact of a Suburban Rapid Transit Line on Fuel Consumption and Cost for the Journey to Work," report submitted to the Federal Energy Administration, December 1975.)

Since low-income people are concentrated in both central cities of larger metropolitan areas and in rural places, there is likely to be a larger variation in the extent to which they can adjust to rising gasoline prices (just as there is a larger dispersion in their gasoline consumption patterns). Upper-income people are most heavily concentrated in suburban areas of large metropolitan areas, where switching to public transit is possible for many, but time consuming. In the long run, adjustments can be made through job and residence changes. These changes are costly, however, and are not likely to be initiated solely in response to energy prices. Rather, higher energy prices would be one factor to be balanced against many other factors that affect the pattern of urban development.

Based on available information, it is not possible to determine the extent to which families will adjust to higher prices by cutting back their gasoline consumption. Perhaps because their driving consists largely of commuting to work, families above the median could cut back proportionately less, at least in the short run.

Impacts on Other Goods and Services

The equalization tax on crude oil would increase the prices of other goods and services (as well as gasoline) to consumers. The gasoline price increase would raise the cost of trucking ^{8/} and that expense for the most part would be passed on to consumers. Products that use oil as an input would also experience cost increases. In addition, taxes would be imposed on all industrial users of natural gas and oil. There are some offsets that would keep the price of some energy-using products from rising. In particular, controls and rebates are intended to prevent price increases affecting gas and oil for residential heating.

It is difficult to identify precisely which goods and services would rise in price and by how much. Furthermore, it is unlikely that all cost increases would be passed on as higher prices, dollar-for-dollar, particularly after the economy has had time to adjust.

^{8/} More than half of for-hire trucks (intercity and local) are gasoline powered; about 45 percent are diesel powered.

The chain of producer and consumer adjustments to increased energy prices would be very complex. There would be changes on the production side induced by the changes in relative input prices. Producers would seek to shift to technologies that use less of the oil- and gas-intensive inputs. Shifts in production would also be induced by changes in consumer demand. As the prices of oil- and gas-using products rise, consumers would be likely to substitute and to buy fewer of the goods increasing in price and more of the goods becoming relatively cheaper. As a result of these shifts in demand and changes in input prices, profits would fall in some industries and rise in others. There would be contractions in some industries resulting in reduced employment and expansions in other industries bringing increased employment. Such adjustments would undoubtedly have regional differences.

The final distributional effects of the induced increases in gas and oil prices would be extremely difficult to tabulate. To do so would require information on many aspects of the economy, including the substitutions consumers would be likely to make among products in response to price increases, the technological possibilities open to producers, and the supply of inputs that would be substituted for gas and oil products. The final effects would influence the earnings and employment of many individuals as well as the relative price consumers pay. In general, however, one would expect that a broad increase in prices would hit families in proportion to their total consumption expenditure. Since consumption generally rises less than proportionately to income, such price increases would be regressive.

TAXES AND TAX CREDITS

Automobiles

Incentives to encourage the purchase of gasoline-efficient cars and to discourage the purchase of gasoline-inefficient cars are contained in a system of rebates for the former and taxes on the latter. As noted above, those in the lowest-income fifth are less likely to own a car or to use cars as much if one is owned. Moreover, when a low-income family does buy a car, it is likely to be a used one. Therefore the tax rebate scheme for new cars is unlikely to involve directly many at the lowest-income levels. Among the rest of the income distribution, one can only guess who would gain and who would lose. The purchase of a new car is related to income, so those with higher incomes are more likely to be involved

in the scheme. Since the taxes and rebates are designed to cancel each other out, however, much of the outcome would be a transfer from high-income purchasers of gas-guzzlers to high-income purchasers of fuel-efficient cars. Since higher-income families tend to purchase a greater proportion of larger cars than do lower-income families, there would also be a transfer of income from high-income (over \$20,000) new car buyers to lower-income (under \$12,500) new car buyers.

Homes

Tax credits are also being offered¹ to induce investments in home insulation and other fuel-saving equipment in the home and for solar heating systems. The home insulation proposal would entitle homeowners to a tax credit of 25 percent of the first \$800 spent and 15 percent of the next \$1,400 to install certain items, such as insulation, storm windows, and improvements in heating equipment. The Administration's proposal also calls for the Federal Home Loan Mortgage Corporation and the Federal National Mortgage Association to help ensure that capital is available to homeowners, at reasonable interest rates through private lending institutions; for energy conservation measures. Another provision of the proposal would increase funds to aid people with low incomes to weatherize their homes.

The home insulation tax credit would be nonrefundable so that families without a federal income tax liability would not be able to take advantage of it. For this reason, and also because home ownership is more limited at lower-income levels, families in the lowest-income fifth would be less likely to participate in the program.

Homeownership increases with income. Only about 43 percent of families in the lowest-income fifth are homeowners, with the percentage rising to 82 percent at the highest fifth. Correspondingly, it is likely that the proportion benefiting from the insulation tax credit would rise with income. It is possible that, among homeowners as a whole, response to insulation incentives could be greater among those at lower-income levels. Such a response is not likely to offset the effect of more homeowners in upper-income brackets, however.

Since 1974, many homeowners have added insulation in response to the increase in fuel prices. According to a 1976 survey for the National Insulation Tracking Study, about 20 percent of owner-occupied homes were reinsulated between 1973 and 1976. The proportion of homeowners who insulated was slightly higher for those with annual

incomes below \$10,000 (about 23 percent) than those with higher incomes (about 19 percent). But the differences would appear too small to offset the larger differences in the percentages owning homes as opposed to renting.

One aspect of the proposal is aimed specifically at the lowest-income households: expansion of the weatherization program for low-income homeowners. The program is currently operated by the Community Services Administration and serves families with incomes up to 125 percent of the official low-income category. In certain circumstances, renters are also eligible for this assistance. The Administration's proposal provides for an increasing level of funding for each year between fiscal year 1978 and fiscal year 1980 for this program.

REBATES AND THE DISTRIBUTIONAL BENEFITS AND COSTS

The Administration's energy package contains two direct cash rebates to consumers--rebate of the crude oil equalization tax and rebate of the standby gasoline tax. The entire tax in each case would not be refunded directly. Some of the equalization tax proceeds would be used as indirect rebates to prevent home heating fuel from increasing in price. (The precise method for the home heating oil exemption has not yet been announced.) Some of the gasoline standby tax would be used to pay for business tax deductions for costs incurred because of the gasoline price rise.

According to CBO estimates, \$15.0 billion (in 1977 prices) would be available for direct cash rebates in 1980; and, in 1985, when the standby gasoline tax is expected to have been triggered, about \$21.9 billion would be rebated directly. These rebates would be distributed as an equal amount per person. Taxpayers and their families would receive their rebates through the tax system. Those who do not pay taxes would be contacted through social security, other transfer programs such as Aid to Families with Dependent Children (AFDC), and through special state outreach programs. Assuming all recipients were found, each family would receive a rebate that varies only with family size. In 1980, the per capita cash rebate is estimated to be about \$197, and in 1985, about \$272 (both in 1977 prices).

Table X-6 shows how the direct cash rebate would vary for families at different income levels in 1980 and 1985. Because average family size generally increases with income, the average rebate would increase with income--though not proportionately. Thus,

TABLE X-6. FIRST-ROUND INCREASES IN EXPENDITURES PER FAMILY RESULTING FROM ENERGY PROPOSALS a/ AND REBATES PER FAMILY, ESTIMATES FOR 1980 AND 1985, IN 1977 DOLLARS

Fifths of Families Ranked by Money Income <u>b/</u>	Induced Cost Increases <u>Relative to Present Policy</u>			Rebate	<u>Net Gain or Loss c/</u>	
	Gasoline	Other Goods & Services	Total		1977	As a Percent
					Dollars	of Real Income
<u>1980</u>						
Lowest Fifth	11	47	58	139	+ 81	+2.8
Second Fifth	23	107	130	165	+ 35	+0.6
Third Fifth	33	162	195	197	+ 2	+0.0
Fourth Fifth	40	217	257	231	- 26	-0.2
Highest Fifth	48	320	368	248	-120	-0.4
Average	31	170	201	197	- 4	-0.0
<u>1985</u>						
Lowest Fifth	49	52	101	195	+ 94	+3.0
Second Fifth	103	113	216	229	+ 13	+0.2
Third Fifth	149	170	319	274	- 45	-0.3
Fourth Fifth	177	231	408	321	- 87	-0.4
Highest Fifth	215	338	553	343	-210	-0.6
Average	139	183	322	272	- 50	-0.3

a/ Gas guzzler taxes and rebates on new cars and home insulation provisions are not included.

b/ The boundaries of each fifth are extrapolated from the 1973-1974 Consumer Expenditure Survey (see Table X-1). Money income was assumed to grow at 6 percent a year until 1977, real income at 2 percent a year to 1980 and 1985.

c/ See note below for discussion of net loss.

NOTE: Gasoline cost increases assumed to be distributed proportionately for gasoline consumption in 1973-1974 (see Table X-1). The increased cost of other goods and services is distributed proportionately to an average of the distribution of gasoline consumption and family income. Total increases in cost of gasoline and of other goods and services assume some reductions in consumption of gasoline and some offsetting consumer substitution. However, given more time for adjustment, cost increases would not exceed rebates and average net cost for all families would be zero. Totals for cost increases and rebates were derived as follows:

	<u>1980</u>	<u>1985</u>
	(in billions of 1977 dollars)	
Increase in Prices Due to:		
1) Crude Equalization	13.5	12.6
(less home heating)	- 0.8	- 0.6
2) User Tax - Industry	8.2	12.2
User Tax - Utilities	--	1.7
3) Controls	- 0.6	- 4.0
4) Gasoline Standby	--	14.9
(less business deductions)	--	- 3.7
5) Coal Conversion Rebates	<u>- 4.9</u>	<u>- 7.3</u>
Total	\$ 15.4	\$ 25.8
Share for Auto Gas	2.4	11.2
Share for Other Goods and Services	13.0	14.6
Rebates:		
1) Crude Equalization	15.8	11.3
(less home heating)	- 0.8	- 0.6
2) Gasoline Standby	--	14.9
(less business deduction)	<u>--</u>	<u>- 3.7</u>
Total	\$ 15.0	\$ 21.9
Number of Families	77.0 million	80.7 million
Average Persons per Family	2.9	2.9

the rebate would be progressive, equalling about 3 percent of income in the lowest fifth in 1980 and declining as a percent of income to less than 0.5 percent for the highest.

The direct cash rebates are the most easily determined part of the proposals. It is much more difficult to determine the indirect effects on the incomes of consumers. As discussed above, families would be affected differently depending on the extent to which goods and services rising in price make up their budgets. In addition, second-order employment and wage effects would have an impact on incomes.

Table X-6 makes a rough attempt to measure how cost increases may affect families at different income levels. Gasoline will be one item experiencing a major price hike. Based on the gasoline consumption patterns shown in surveys and discussed above, the effect of increases in gasoline prices on family gasoline expenditures can be calculated. The estimates shown in Table X-6 assume that all families would cut back somewhat in their fuel consumption and at approximately the same rate (see Chapter 6).

Increases in expenditures per family on goods and services other than gasoline were calculated based on an estimate of the aggregate increase in prices induced by the energy program. It was assumed that these other goods and services would rise with income but less proportionately.

It should be noted that the total amount of price increases exceeds the amount of direct cash rebates in 1980, primarily because the tax on industrial users would not be included in the direct cash rebate. However, if tax deductions of a comparable amount were granted so that there were no net tax increase, the amount would be indirectly refunded in the form of some price reductions or changes in income. Therefore, the average net loss to families in 1985 could eventually be reduced to zero (instead of \$50). However, the general pattern of net gains for low-income families and net losses for high-income families would not necessarily change. In 1985, rebates would be slightly larger than price increase because of decreased natural gas prices relative to present policy. Because of the very intricate changes in the economy that would be likely to occur, the final incidence of price changes might be quite different from those shown; this should be remembered when interpreting Table X-6.

As shown in Table X-6, the increased cost per family attributable to the energy program would be regressive; that is, increased

cost as a percent of income falls as income rises. the rebates contained in the program would be highly progressive, however, and the net effect (increased costs and rebates together) would be progressive as a result. The average family in the lowest-income level should gain the most since the net cost rises proportionately faster than income. Of course, within income classes there would likely be considerable variation in the net gains or losses. Low-income families with automobiles would experience much steeper cost increases than the average low-income family. The rebate might not cover the cost increases for low-income families that must drive long distances to work.

In general, because the cash rebate would vary only by family size and would not take into account other factors affecting consumption, it would tend to redistribute income to low-income families who do not use automobiles. Represented in this group would be families consisting of retired persons and families living in central cities, particularly in the Northeast.

The proposed rebates are not designed to reflect any other form of compensation for energy-related price increases that might have been received by families. Thus, individuals whose incomes are automatically adjusted for changes in the Consumer Price Index (CPI)--such as social security recipients and workers whose wages are tied to cost of living escalations--would receive compensation twice for the energy-induced price rises.

Is the tax and rebate system fair? Very roughly, going up the income ladder, the plan would be progressive and would impose relatively greater costs as income increases. However, within income classes, the gains and losses would likely be extremely variable and therefore many might not consider them fair. Because of the greater variations in automobile use within lower-income levels, particularly related to commuting to work, this might be the area of greatest concern.

It is, of course, enormously difficult to design a rebate that takes into account individual circumstances and is administratively feasible. One possible alternative would be to give rebates of a somewhat larger amount to workers. This would provide some adjustment for increases in the cost of commuting, which would be one important source of dispersion in the cost of the gasoline tax.

Dr. RIVLIN. Thank you, Mr. Chairman.

Mr. DINGELL. The next panel is a panel on long-term issues.

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FOSSIL
EVALUATION OF THE NATIONAL ENERGY PLAN

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EVALUATION OF THE NATIONAL ENERGY PLAN

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I. INTRODUCTION

Over the past five years, the nation's perception of its energy future has altered dramatically. As late as 1972, United States energy policy was based on a vision of the future drawn unrealistically from past growth trends--energy consumption was seen as continuing to expand at historical rates, requiring increased domestic oil and gas production, more nuclear reactors, and rising imports to meet demand.

In 1973, however, the energy problem was thrown into graphic perspective. The Arab oil embargo brought home the vulnerability of this country's energy system to price rises in imported oil. It became eminently clear that the United States could not depend on this energy source to satisfy its demand. Then, in 1975, the U. S. Geological Survey, under pressure from the increasingly-convincing evidence of a number of independent studies (Hubbert 1974; NAS 1975; Moody & Geiger 1975), lowered its estimate of the remaining domestic oil and gas resource base by a factor of six (USGS 1975, p.4). Domestic oil and gas production had peaked in the early 1970's and now seemed likely to continue declining in the future. Demand for energy was continuing to spiral. A transition away from oil and gas to alternative energy sources was recognized as the only solution by which the United States could produce enough energy domestically to meet demand. Yet it was also clear that this transition could not be made overnight.

Today, the energy policy options open to this country must be weighed carefully, with full recognition of the difficulties inherent in the transition. Each possible alternative energy source--nuclear power, coal, synthetic fuels, breeder reactors, solar power--presents major problems as an immediate substitute for cheap, clean, convenient oil and gas. Technological, environmental, economical, and ethical questions must be answered about each option. The energy policymakers must somehow determine the tradeoffs implicit in the support of one or more of these options, and choose a combination of policies which will assure adequate short-term and long-term energy supplies. Furthermore, if the transition is to be a smooth one, energy policy must be directed not only toward increasing production, but toward decreasing consumption through strong energy conservation measures.

In 1975, members of the Dartmouth System Dynamics Group were contracted by ERDA's Division of Fossil Energy to build an energy policy model. The model's purpose was to serve as a simulation device to evaluate the magnitude of the United States energy transition problem, and to assess the impacts of various energy policy options on the United States energy system. Thus, FOSSIL1, an expanded version of the COALL system dynamics model developed under a grant from the National Science Foundation, was conceived and constructed.

The model's completion in early 1977 seems particularly fortuitous, considering the evolution of the world energy situation. FOSSIL1 can provide the type of analysis desperately needed by ERDA and other federal energy agencies--it can forecast the integrated dynamic behavior of the energy system. In addition, FOSSIL1 can test the effects of the wide spectrum of policies which are available to the federal government and the private energy sector.

We recently applied these policy-testing capabilities of FOSSIL1 to perform an evaluation of the long-term effectiveness of the National Energy Plan introduced by President Carter on April 20, 1977. This report summarizes the results of our analysis, which focused on three specific questions:

1. Can the National Energy Plan achieve its 1985 goals?
2. How effective is the Plan after 1985?
3. Could additional policies secure United States energy independence by 2000?

II. ANALYZING THE NATIONAL ENERGY PLAN

To evaluate the effectiveness of the National Energy Plan, we compared the Plan to a Business as Usual projection, which assumed no changes in current energy policies. It is important to realize when judging these comparisons that the dates and numbers of quads cited in this analysis (or any analysis accomplished with the aid of a model) should not be viewed as absolute predictions--the large uncertainties involved in any long-term projection preclude that. They should be interpreted rather as indicators of the relative magnitude of change that can be expected from one projection in comparison with another.

In the Business as Usual projection, government policies remain at their current (May, 1977) status. Oil and gas prices continue to be regulated. (A ceiling price that returns 12 percent per year to the oil and gas industries is enforced.) No mandatory conservation programs are imposed--consumers conserve energy voluntarily in response to energy price increases. No new taxes or tariffs are initiated. No new environmental legislation is imposed (and, perhaps as important, current environmental legislation--SO₂ standards and the 1969 Coal Mine Health and Safety Act--remains in force). ERDA's Research, Development and Demonstration (RD&D) programs for advanced energy technologies are continued at their current scheduled pace. None of the policy options proposed in the National Energy Plan are implemented.

The National Energy Plan (NEP) projection incorporates into the model the roughly 40 major energy policies comprising President Carter's Energy Plan (see The National Energy Plan, Executive Office of the President, April, 1977). The salient features of the Plan, which we translated into the model via a total of 35 structural and parametric changes,* include policies meant to:

- increase energy conservation and fuel efficiency;
- raise the price of oil and natural gas;
- encourage the conversion to coal;
- promote limited development of nuclear power;
- stimulate the long-term development of renewable resources.

* A description of how the NEP policies were represented in the FOSSIL model is included as APPENDIX A.

In general, the FOSSILL model's structural representation of energy decision-making* allowed us to capture the effects of specific policies within the Plan in rich detail. Conservation policies were represented by enhancing the energy users' responsiveness to price changes. For the same price increase, consumers reduce their energy usage by a larger amount and switch to more energy-efficient end-use technologies. The Plan's fuel-specific energy tax packages were incorporated directly into the model structure, for FOSSILL energy prices are broken down by fuel / type.

The myriad of regulatory restrictions concerning prohibition of new oil- and gas-fired utilities, scrubber requirements for coal-fired plants, strip mining legislation, bans on breeder reactors and commercial reprocessing and recycling, reductions in light water reactor siting delays, and accelerated research and development in advanced energy technologies were also represented directly in the model structure.

We had difficulty identifying structural changes we could make in the model to represent the National Energy Plan's oil and gas pricing rules, which peg prices to fixed or target price levels (for example, \$13.50 per barrel for new oil). While such levels may be perfectly appropriate in 1977 or even into the 1980's, they certainly cannot be expected to remain unchanged to the year 2000. The original FOSSILL BAU pricing structure contains a flexible representation of regulatory pricing that adds enough profits to average oil and gas costs to allow the industry a fair rate of return (the historical total industry average of 12 percent per year after taxes). In fact, this pricing structure projected future oil and gas price paths that seemed an appropriate representation of the NEP pricing scheme. Thus our assumption is that the price increases called for in the NEP would have occurred anyway under the BAU. The Plan clearly does not include any major structural changes in oil and gas pricing, such as deregulation.

*A detailed description of the FOSSILL model structure and assumptions is included in APPENDIX B.

III. CAN THE NATIONAL ENERGY PLAN ACHIEVE ITS 1985 GOALS?

The National Energy Plan sets forth ambitious energy goals for 1985. These goals are:

- reduce the annual growth of total energy demand to below 2 percent;
- reduce gasoline consumption 10 percent below its current level;
- reduce oil imports from a potential level of 16 million barrels per day to 6 million, roughly one-eighth of total energy consumption;
- establish a Strategic Petroleum Reserve of 1 billion barrels;
- increase coal production by two-thirds, to more than 1 billion tons per year;
- bring 90 percent of existing American homes and all new buildings up to minimum energy efficiency standards; and
- use solar energy in more than two and one-half million homes.

Because the FOSSIL model focuses only on the long term interactions of the nation's energy supply and demand system, we limited our analysis to those three goals which address the system on an aggregate level--total energy demand, oil imports, and coal production. Figure 1 compares the results of the FOSSIL BAU and NEP projections with the President's goals in 1985.

Demand

Gross energy demand is reduced from 102 quads in 1985 under BAU to 95 quads with the National Energy Plan (see Figure 1). This represents a growth rate of 2.2 percent per year, close to the President's goal of 2 percent per year over this period. The declining growth in demand is the result of NEP policies which both raise the price of energy directly (standby gasoline tax, crude oil equalization tax) and also offer incentives for users to respond to price increases (gas guzzler tax and rebate, fuel efficiency

VARIABLE	1976	1985 NEP GOAL	FOSSIL PROJECTIONS	
			1985 BAU	1985 NEP
DEMAND	Quads: 77	96	102 (101-103)*	95 (90-97)
OIL IMPORTS	MPBD: 7.3 Quads: 15	6 12	16.5 35 (32-37)	12.7 27 (24-29)
COAL PRODUCTION	10 ⁹ Tons: 0.66 Quads: 15	1.2 26	0.94 20 (20-21)	1.08 24 (23.5-24.5)

*Figures in parentheses indicate high and low values from sensitivity tests on imports, prices, demand elasticity, conversion technology costs, and oil and gas resource estimates.

FIGURE 1: EVALUATION OF THE NATIONAL ENERGY PLAN TO 1985

standards). While the FOSSILL model is not capable of capturing the detailed response of consumer demand to price changes, our aggregate analysis indicates that the energy savings proposed as a goal for the country in the National Energy Plan are within reach.

Oil Imports

United States demand for oil imports increases to 35 quads (16 mbpd) in 1985 under BAU in the FOSSILL model. With the implementation of the National Energy Plan, oil imports drop 8 quads to 27 quads per year (13 mbpd). While this represents a significant savings, this level is still double the NEP goal of 12 quads (6 mbpd). The difference lies in our estimates of petroleum production. While the NEP goal assumes a modest increase in oil production (10 percent) by 1985, the FOSSILL model projects that the current downward trend will continue, resulting in a net decrease in domestic petroleum production (to 11 quads or 5 mbpd). Almost all of the model's projected 8-quad decrease in oil imports under NEP is accomplished by lowered demand, rather than by increased production.

Coal Production

The National Energy Plan sets a goal of increasing coal production to 1.2 billion tons per year in 1985. Our analysis suggests that coal production may fall slightly short of that goal, reaching 1.08 billion tons per year. The limitations to coal production result from demand constraints over the short term, when coal is used primarily as a boiler fuel in either the industrial sector or in electricity generation. While it appears possible to achieve the industrial usage goals with a major coal conversion program, coal usage in utilities falls about 150 million tons short of the NEP goals by 1985. The utilities' demand for coal is limited by the reduction in electricity demand growth accompanying the NEP (which limits the number of new coal-fired plants constructed in this time period), and by the restricted ability of existing plants to convert to coal.

In summary, the FOSSILL projections suggest that although both the demand and the coal production goals set by the National Energy Plan may be generally achievable by 1985, the Plan will fall short of attaining its most important goal. Oil imports will rise to 27 quads (13 mbpd) in 1985 with the Plan, instead of dropping to 12 quads (6 mbpd). As disturbing as this discrepancy may be in the short term (up to 1985), it is even more critical over the long term. The FOSSILL model projects that a world oil shortage could begin in the early 1980's; a miscalculation in our level of dependence on foreign oil would dramatically increase the stress that such a shortage would place on the United States economy.

IV. HOW EFFECTIVE IS THE PLAN AFTER 1985?

The FOSSIL model indicates that the United States is on a path toward increasing imports to 1985, *no matter what policies are implemented today*. It is too late to affect 1985 imports--because of the long time lags in the energy system, the decisions leading to 1985 have already been made. Yet, there is still time to shape the post-1985 future. The National Energy Plan goes a long way toward improving the long-term energy prospects of the United States, as our year 2000 analysis shows.

Demand

Figure 2 illustrates the FOSSIL model's projections of gross and net energy demand (by fuel type) under BAU and the Plan. Gross energy demand is shown to grow to 142 quads per year in the year 2000 under BAU, compared to 118 quads with the Plan. Energy demand grows at 2.5 percent per year to the year 2000 under BAU, and only 1.8 percent per year with the Plan. The National Energy Plan package of conservation and energy tax policies therefore could reduce energy demand growth below the NEP target level of 2 percent per year over the long term. Yet even with reduced demand, the oil and gas burden is sizeable to the year 2000--these fuels still must satisfy the bulk of United States energy consumption over the transition period (50 percent by the year 2000 with the NEP).

Oil

Figure 3 demonstrates that United States oil supply and demand are strongly affected by the policies of the National Energy Plan. The conservation and tax policies of the Plan reduce demand for oil by about 20 quads (9 mbpd) in 2000. However, the benefits of reduced oil demand are partially offset by the Plan's net depressive effects on domestic oil production (5 quads or 3 mbpd less in 2000). Domestic production is controlled largely by the world oil price under the National Energy Plan. The Plan's conservation programs lower United States demand for foreign oil (and therefore lower the world oil price) over the long term, resulting in reduced incentives for domestic production during this period. Although domestic production is lower, the net effect of the Plan on the oil sector is positive--United

FIGURE 2: FOSSIL FUEL DEMAND PROJECTIONS

FIGURE 3: FOSSIL OIL PROJECTIONS

States demand for imported oil (oil imports plus shortage) is reduced 12 quads (5 mbpd) to 25 quads (12 mbpd) in 2000.

Gas

The supply and demand for natural gas is shown in Figure 4. Because of the declining availability of gas, the United States would suffer a persistent, major gas shortage over the next 25 years with BAU. The National Energy Plan policies cut down the severity of the gas shortage through conservation measures; the shortage is eliminated by the late 1990's with the Plan. Our analysis found that the Plan's natural gas pricing strategy effectively left gas prices the same as they would have been under BAU (indicating that the proposed price increases of the Plan would soon occur anyway under BAU). Therefore, domestic gas production is unchanged over most of the model's time horizon (until 1995) with the NEP policies.

Coal

Figure 5 shows that the National Energy Plan has a net stimulative effect on the coal industry. Coal production increases to 44 quads (2 million tons) in the year 2000 with the Plan, compared to 39 quads (1.8 million tons) under BAU. The added coal demand from the Plan's coal conversion programs more than offsets the major reduction in end-use energy demand achieved by the Plan. United States dependence on coal increases strongly from 29 percent in 2000 with BAU to 37 percent with the Plan.

Electricity

Electricity use grows significantly in both projections, increasing to meet 25 percent of end-use energy demand in 2000 (see Figure 6). Yet, because of the reduced growth rate in demand achieved with the Plan, electricity demand grows at 4.5 percent per year, as opposed to the 5.2 percent annual growth rate under BAU. Nuclear power and coal contribute equally to electricity generation under both scenarios--35 percent of electricity is generated by each in 2000.

FIGURE 4: FOSSIL Gas PROJECTIONS

FIGURE 5: FOSSIL COAL PROJECTIONS

FIGURE 6: FOSSIL ELECTRICITY PROJECTIONS

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Energy Prices

Figure 7 illustrates the net effect of the National Energy Plan on energy prices. Consumer prices are increased slightly over the short term (before 1985) with the Plan, as the Plan's consumer tax policies take effect. Yet the conservation package of the Plan creates an offsetting downward pressure on prices over the long term, due primarily to the reduction of world oil prices. Figure 7 shows that the various taxes on petroleum increase the price paid by oil consumers about 40 percent above the world oil price in the NEP projection. Yet when these taxes are combined with the lower world oil price resulting from the Plan, there is almost no net change in the consumers' average energy price between the BAU and NEP projections. In both cases, the average price paid by consumers for energy increases by a factor of three above current (1977) levels in real dollars by the year 2000.

OPEC

The supply and demand for oil from the oil-exporting nations (loosely defined here as OPEC) is shown in Figure 8. In the BAU projection, world demand for oil from the oil-exporting nations exceeds their capacity to produce in the early 1980's. A world oil shortage develops, even though the OPEC nations have expanded their production capacity steadily (to 45 mbpd by 1985). The United States contributes significantly to the crisis; Figure 8 shows that its share of total world demand for imports escalates from less than 20 percent before 1970 to 35 percent in 1985. As the shortage develops, the world oil price "breaks" from its current 13.50 dollar per barrel level, and begins to rise to the marginal cost of oil substitutes, priced near 25 dollars per barrel.

Because the United States is likely to become a major oil importer under the BAU, any reduction in United States imports could produce significant repercussions in the world oil market. The large United States oil savings projected with the National Energy Plan (as much as 9 mbpd) are not enough to avoid a world energy shortage entirely--this crisis seems inevitable given the limited resource base of the OPEC nations. Yet the *National Energy Plan postpones the world oil shortage for ten years*, from 1983 to 1993 in the FOSSIL simulations. This delay is crucial for the development of United States energy policy, buying the country ten additional precious years to bring alternative energy sources on line. If the strong conservation program of the National Energy Plan were supplemented with additional policies that stimulated supply, the United States could achieve energy independence by the year 2000. Under these circumstances, the United States would be insulated from the direct effects of a world oil shortage.

FIGURE 7: FOSSIL PRICE PROJECTIONS

FIGURE 8: FOSSIL OPEC OIL PROJECTIONS

V. ALTERNATIVE ENERGY PLANS

In view of the previous results, we tested two alternative energy plans with FOSSIL. Both strategies modify the National Energy Plan to increase incentives for domestic energy production, in order to insulate the United States against a world oil shortage over the long term.

NEP Plus Accelerated Supply

This plan acknowledges that even if the United States were to return to free-market energy pricing, adequate domestic energy supplies would still not be forthcoming; foreign oil would remain the most attractive alternative, even at \$13.50 per barrel. Under our Accelerated Supply projection, government intervenes to stimulate domestic supply by modifying the National Energy Plan with the following policies:

- Oil and gas prices are deregulated over a five-year period;
- No oil and gas users' taxes are imposed;
- A substantial tariff is imposed on imported oil, bringing its price to \$22.50 per barrel.

Deregulation allows oil and gas producers to price their products nearer to their replacement costs. The oil tariff ensures that the cheapest replacement will be domestic oil and gas, rather than imported oil. By removing the users' taxes (and perhaps by regulating investment flows), the additional revenues from higher oil and gas prices flow to new domestic investments.

Figure 9 summarizes the net effects of the Accelerated Supply Plan on the energy balances in the year 2000. United States demand for foreign oil (imports plus shortage) is decreased to 12 quads (6 mbpd) by 2000, the goal of the National Energy Plan. As with the original NEP projection, the world oil shortage is postponed almost to 2000 due to the United States' conservation efforts. By the time the oil shortage erupts, the United States is well along toward a path to energy independence.

	BAU (quads)	NATIONAL ENERGY PLAN (quads)	NEP & ACCELERATED SUPPLY (quads)	NEP & ACCELERATED COAL (quads)
<u>DEMAND</u>	<u>142</u>	<u>118</u>	<u>118</u>	<u>121</u>
<u>DOMESTIC SUPPLY</u>	<u>96</u>	<u>89</u>	<u>103</u>	<u>110</u>
OIL	14	7	18	18
GAS	12	9	11	11
COAL	40	44	45	73
NUCLEAR	25	23	23	1
OTHER	5	5	6	6
<u>IMPORTS</u>	<u>31</u>	<u>23</u>	<u>14</u>	<u>11</u>
OIL	26	19	11	9
GAS	5	4	3	2
<u>SHORTAGE</u>	<u>15</u>	<u>6</u>	<u>1</u>	--
OIL	11	6	1	--
GAS	4	--	--	--

FIGURE 9: COMPARISON OF ALTERNATIVE ENERGY PLANS: YEAR 2000

NEP Plus Accelerated Coal

Although in the previous plan the government intervened to accelerate future domestic energy supply above expected free-market levels, it allowed the energy market to choose which of the many supply alternatives would be exploited. Within the limitations of existing law, the market responded by choosing the cheapest and most profitable alternatives--primarily nuclear power and coal-based energy sources over the next 25 years.

Yet there are environmental and political tradeoffs implicit in any energy strategy which aren't accounted for in the current energy market. For example, environmentalists argue that nuclear power poses greater risks than coal as an energy option, for its problems are more long-lived and intractable than coal's. Is nuclear power crucial to the United States energy future? Could reliance on coal alone protect this country from the world oil shortage?

To answer these questions, we ran the FOSSILL model with the same policies as the previous run (NEP plus Accelerated Supply), and added the following policies:

- a nuclear moratorium;
- loan guarantees for synfuel projects.

As shown in Figure 9, the answer is yes--national goals could be met over the long term without major increases in nuclear power. Domestic energy production increases to 110 quads when the Accelerated Coal policies are added, a 15 percent increase over BAU. Coal production increases to over 70 quads (3 billion tons per year) in 2000, and provides over 60 percent of the nation's energy in that year. Oil imports are reduced to 9 quads (4 mbpd), which is lower than the plans that included nuclear power. The NEP plus Accelerated Coal projection shows that an energy transition heavily based on coal should at least be considered as a feasible option.

V. CONCLUSIONS

With the aid of the FOSSIL energy model developed at the Thayer School of Engineering, the Dartmouth System Dynamics Group has tested the long-term impact of President Carter's proposed National Energy plan. Our analysis leads us to the following conclusions:

- The National Energy Plan is first and foremost an energy conservation strategy, and as such we strongly endorse it. From our perspective, however, it does not go far enough--the Plan does not fully recognize the severity of the long-term problem.
- The Carter Administration's 1985 goal of a reduction in imports is overly optimistic. Our analysis projects that imports will increase to 13 mbpd even if the Plan is implemented. The energy system's inertia along its present course will carry the country towards increasing imports to 1985, no matter what policies are enacted now.
- Over the longer term (to 2000), the Plan has measurable positive effects. By reducing United States energy demand, the Plan postpones the world oil shortage for ten years, to the mid-1990's. While the Plan does not totally circumvent the domestic impact of the oil shortage (United States demand for foreign oil is still 13 mbpd in 1995), the added ten years buy this country time to bring alternative energy sources on line.
- By adding to the Plan policies that accelerate supply, United States' dependence on foreign oil could be reduced to 5 mbpd by 2000. This plan would achieve the President's medium-term energy goal, effectively insulating the United States from a world oil shortage.
- With the major reduction in demand that is a consequence of the Plan, nuclear power is no longer a critical part of the United States' energy supply future. Our analysis indicates that even with a moratorium on nuclear power, the goals of the National Energy Plan could be met by accelerating coal production and use. In fact, oil imports could drop even further to 4 mbpd when accelerated coal policies are added to the National Energy Plan.

Central to our analysis is the concept that there is a strong conflict between the economy's short-term and long-term well being. The policies that improve the long-term behavior of the energy system require significant short-term sacrifices by the American people--1985 energy prices under the alternative energy plans are as much as 30 percent higher than those in the Business as Usual projection. This prospect is not a popular one, for the country, its leaders, and individual consumers already feel the serious side-effects of rising energy prices.

Yet over the long term, there is little doubt that the benefits of a National Energy Plan will more than offset its short-term costs. Many studies have come to refer to their Business as Usual projections as "surprise-free," indicating that these scenarios conform to most people's current expectations of the future. However, our Business as Usual projection is full of unpleasant surprises. Major energy price increases seem inevitable, even under the Business as Usual scenario. Moreover, there is mounting evidence from both our analysis and others (CIA 1977, WAES 1977) that the Business as Usual path leads to a world oil shortage, perhaps just five years from now. The implementation of a strong National Energy Plan should be this country's most pressing order of business.

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APPENDIX B:

INTRODUCTION TO THE FOSSILL MODEL

I. INTRODUCTION: THE ROLE OF SYSTEM DYNAMICS MODELS
IN ENERGY POLICY ANALYSIS

The United States energy system is a complex and unwieldy social system, whose behavior is characterized by a number of perplexing properties: inertia, interconnectedness, unforeseen side effects, and short-term versus long-term tradeoffs. Years may pass before a policy change alters behavior; such a change may produce ramifications in a part of the system far away from its expected area of effectiveness; some of these ramifications may be unpredictable and perhaps even undesirable; and a policy designed to improve long-term behavior may have unpopular short-term results.

These qualities are all characteristic of a class of systems called multiple-loop nonlinear feedback systems. All complicated social systems tend to be composed of interrelated "positive" and "negative" feedbacks, the positives tending to amplify changes or disturbances, the negatives tending to counter or control those disturbances. When several such loops interconnect, the consequences of any change become difficult to predict, especially as each loop takes its toll over different periods of time. For example, deregulation of natural gas prices might lead to a short-term increase in supply. However, domestic gas production might actually decrease more quickly over the long term with deregulation, as increased short-term production uses up the cheaper domestic resources, leaving lower resource levels for production over the long term.

System dynamics is a modeling technique developed specifically to analyze the behavior of such complex, nonlinear systems. The field integrates three distinct disciplines to analyze social systems: feedback control theory, organizational behavior, and computer simulation technology. The focus on the interrelationship between system stocks and flows (implying the existence of feedback loops) is drawn from feedback control theory. The idea that social systems -- systems involving human decision-making processes -- can be modeled with the same techniques as physical systems stems from the field of organizational behavior. Computer simulation techniques provide the means to analyze complex, nonlinear systems.

Thus system dynamics, the modeling technique used in FOSSILL, was designed specifically to model systems like the United States energy system. From its inception in the study of industrial systems, system dynamics has grown to provide a framework for understanding the behavior of urban, world, economic, and energy systems whose elements interact through time to produce system changes. System dynamics has several specific advantages over other formal modeling techniques in analyzing the energy system.

1. Focuses on dynamic behavior. The FOSSIL model is a fully dynamic, disequilibrium model of the United States energy system. It does not assume that markets always clear or that they function in an optimal manner. Instead, the model portrays the actual decision rules governing the flow of investment, resources, and energy-consuming goods. The current energy problem is a manifestation of disequilibrium behavior--rapid resource depletion, rising energy prices, and a massive shift in investment toward alternative energy sources.

2. Displays a causal theory of behavior. The FOSSIL model generates behavior modes such as oil and gas production life cycles from the interaction of internal mechanisms. The model structure therefore represents a causal theory of the energy problem. This feature is critical if the model is to be used as an input to policy decisions. A causal model allows policymakers to better understand the genesis of the energy problem, and provides a milieu to experiment with policy changes designed to improve system behavior.

3. Incorporates system nonlinearities. The FOSSIL model incorporates a number of nonlinear relationships that are central to the United States energy transition problem. Nonlinear relationships are needed to show, for example, how energy production costs and prices rise as a result of resource depletion, or how consumers change their use of fuels as incomes rise or relative energy prices change. By incorporating a full range of nonlinear relationships, the FOSSIL model is able to explain how shifts in the behavior mode of the energy system may arise. For example, the model shows how behavior can shift from a period of rapid energy growth, low imports, and low prices, to a period of inflated energy prices, slower growth in demand, and chronically rising imports. By generating such behavioral shifts internally, the model should help to anticipate future problems and develop appropriate policy responses.

Does this mean that the FOSSIL model can effectively be used to analyze all the problems of the United States energy system? Definitely not. Because of the inherent limitations in any model's ability to capture both the structure and parameters of a complex socioeconomic system, the projections of FOSSIL must not be expected to produce exact quantitative predictions. The model was designed to investigate the dynamic behavior modes of the energy system over time. It provides a policy tool for identifying the direction and relative magnitude of

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changes in system behavior induced by a change in energy policy.

The strength of such a model is that it becomes a learning tool by which the user can enlarge and clarify his own understanding of the energy system. He can observe exactly how his assumptions fit together, interact, and result in a complex long-term behavior pattern. As he observes how and why alternative assumptions change the system's behavior, he can begin to derive a deeper perception of the general principles by which the system is guided, and his role as an effective energy policy-maker can be greatly enhanced.

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II. FOSSIL OVERVIEW

This chapter describes how the design and structure of FOSSIL work to approximate the behavior of the United States energy system. Because the system is characterized by complex supply and demand mechanisms, FOSSIL has been divided into two corresponding segments, a general demand sector and four supply sectors.

Energy Demand and Supply Sectors

The FOSSIL model projects energy demand, gross energy production, and net energy use for the United States. Figure B-1 illustrates the distinction between gross energy production and net energy use embodied in the model. Energy consumers (from the residential, commercial, transportation, and industrial sectors of the economy) demand a certain amount of energy each year as oil, gas, coal, or electricity. Producers attempt to meet this demand by extracting, refining, and converting adequate amounts of energy. Because the conversion of energy always incurs significant energy losses, gross energy production is always greater than net energy use. In 1975, for example, conversion losses amounted to 19 percent of gross energy production (USDI 1976, p.57). Conversion losses should increase in the future as the nation shifts to less efficient (but perhaps more readily available) energy forms such as electricity or synthetic fuels from coal.

In addition to the demand sector, the model contains four major energy supply sectors--oil, gas, electricity, and coal. These four sectors must produce enough of each energy product to satisfy demand. Figure B-2 illustrates the alternative sources of oil, gas, electricity, and coal represented in the FOSSIL model.

Energy Flows and Constraints in FOSSIL

The flow of United States energy from primary resources to satisfaction of end-use demand represented in the FOSSIL model is illustrated in Figure B-3 (without overlay). From this perspective, the United States energy system extracts, refines, and converts primary energy into five delivered energy products: electricity, coal, oil, gas, and "decentralized" energy (representing solar-thermal heating of homes).

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FIGURE B-1 ENERGY SUPPLY AND DEMAND IN FOSSIL

FIGURE B-2: SOURCES OF ENERGY SUPPLY IN FOSSIL

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FIGURE B-3: FOSSIL ENERGY FLOW NETWORK

Energy is lost in each stage of refining and conversion, with most of the loss occurring in the conversion of primary energy to synthetic oil and gas and to electricity.*

The solid arrows in the energy network of Figure B-3 represent energy flow rates, measured in quads per year in FOSSILL. (Equivalent to one quadrillion Btu's, the quad is the energy unit appropriate to the scale of the United States energy system.) The overlay for Figure B-3 (in red) shows that each energy flow rate can be thought of as controlled by a valve (represented by X in the diagram. FOSSILL is designed to explain how these flows change through time. The end-use demand valves have been steadily opening at an average rate of 3 percent per year for the past 25 years, due primarily to growth in energy-intensive goods and services (GNP). Increasing end-use demand for energy has necessitated a rise in production and conversion of primary energy resources over history.

Each of the energy flows shown in Figure B-3 corresponds to specific production processes in FOSSILL. The energy flows are controlled by three "factors of production"--labor, capital, and resources (represented by the red boxes L, C, and R). These factors are called levels (or state variables), and are the basic building blocks of the FOSSILL model. Figure B-3 indicates the specific combination of capital, labor, and resources, that constrain each of the energy flow rates included in FOSSILL.

It is easy to visualize a "snapshot" of the system shown in Figure B-3 at an instant in time: energy capital, labor, and resources are constant and define a steady energy flow rate through each of the valves.** In reality, however, the availability of energy resources, capital, and labor are changing in complex ways over time: oil and gas resources are being depleted, energy investment decisions are shifting rapidly, and the labor supply for underground coal mining is becoming an increasingly constraining input to coal production. The FOSSILL structure reproduces the complex interaction of geologic, economic, environmental,

* Synthetic conversion processes are typically 60 percent efficient, and electrical conversion processes have an average efficiency of 34 percent.

** The Brookhaven Reference Energy System provides such snapshots for selected years (Brookhaven 1974).

and technological factors that control the dynamics of energy labor, capital, and resources.

Ideally, domestic energy flows from primary resources should be sufficient to meet end-use demand; there should be little need for imports as an energy source. Yet due to oil and gas depletion and regulation of domestic oil and gas prices, domestic energy flows have fallen well behind demand over the past 25 years. Oil imports have consequently increased to 20 percent of United States energy consumption in 1975. A unified national energy policy is needed to bring the energy system back into balance.

However, as Figure B-3 implies, the influence that policymakers command over the flow of energy through our energy system is at best indirect. Government energy policies (such as price deregulation, research and development, or environmental legislation) work to influence the availability of the three factors of production, but they must operate within the economic and physical decision-making structure that constrains the behavior of the United States energy system. The FOSSILL model simulates this decision-making environment, allowing the model user to alter the model's decision rules to match proposed government policies.

Dynamic Mechanisms of Energy Supply and Demand

The future direction of the United States energy system is determined largely through the market interaction of energy producers and consumers. If deemed necessary, government energy policies can perturb the system by interfering with the normal market mechanisms of energy supply and demand. The FOSSILL model captures both the decision-making processes of producers and consumers and the major government policy levers within its structure.

Figure B-4 shows the basic interactions between energy producers and consumers included in FOSSILL. In the demand half, energy consumers make a decision to utilize oil, gas, coal, or electricity based on both price and availability of the fuels. Energy producers, in turn, choose to invest in the product that maximizes the industry rate of return (or minimizes the average cost of production), subject to environmental constraints (SO₂ restrictions or water availability) or market limitations (low-Btu gas can satisfy only a fraction of final gas demand because it is uneconomic to transport long distances through existing pipelines).

B-9

FIGURE B-4: BASIC MARKET-CLEARING MECHANISMS IN FOSSIL

B-10

Both end-use consumption decisions and producers' investment decisions accumulate through time to determine the net demand and production capacity for each fuel. If an imbalance develops between demand and capacity, then energy prices adjust through market forces to restore the balance (in the absence of price regulation).

Figure B-5 illustrates the basic dynamic mechanism of the energy transition problem--the depletion of oil and gas. As conventional resources are depleted, both the costs and the prices of oil and gas rise. On the demand side, price increases encourage consumers to conserve energy and shift away from oil and gas toward coal and electricity. On the supply side, rising conventional production costs stimulate domestic oil and gas producers to develop alternative sources of oil and gas.

Although energy price variations tend to balance energy supply and demand over time, several dynamic features of the energy system make the current energy imbalance unusually difficult to resolve:

1. Expensive alternatives. During past energy transitions, new energy sources were both cheaper and more convenient than their predecessors (as in the transitions from wood to coal and from coal to oil and gas). In the current transition, there is no cheap, convenient alternative to oil and gas.

2. Continued growth. As the economy grows, so will energy demand. Continued energy demand growth exacerbates the transition problem by creating increasing needs for a dwindling resource: oil and gas.

3. Adjustment delays. Full adjustment of the energy system to changes in the price and availability of oil and gas can take fifteen to thirty years. Energy users cannot change consumption patterns quickly, even in the face of rapid price increases. Energy producers need time to develop viable alternatives to conventional sources of oil and gas--new enhanced recovery techniques, shale oil, or synthetic fuels from coal.

The resolution of the energy transition problem requires some difficult decisions by both public and government policymakers. Tradeoffs must be made between higher prices and decreased availability, between adverse environmental impacts and increased domestic production, and between increased political vulnerability and increased government intervention. The FOSSIL model structure is designed to isolate these tradeoffs.

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FIGURE B-5: BASIC MECHANISMS OF THE ENERGY TRANSITION

III. ENERGY DEMAND

The FOSSIL demand sector forecasts the response of energy demand (specified by fuel type) to change in GNP, energy prices, fuel availability, and fuel convenience. Figure B-6 illustrates the two central mechanisms at work in the demand sector of the model.

Size of Demand

Total energy demand (the size of the pie in Figure B-6), is determined by GNP and the average price of energy. Energy demand grows with increasing GNP, but at a less than proportional rate. Thus the energy /GNP ratio declines with increasing GNP as output shifts to services and light industrial goods, which are less energy-intensive than heavy industrial production. Energy price increases can also induce further energy savings, as consumers shift to more energy-efficient end-use devices (for example, higher-mileage cars, or improved insulation). Because of the long lead time required to replace end-use capital with new, more energy-efficient goods, the full effects of price-induced energy conservation are not felt for an average of fifteen years.

Energy demand is projected to grow significantly slower than GNP in the FOSSIL model, due primarily to rapid energy price increases. Figure B-7 illustrates that although GNP increases at an average rate of 3.2 percent per year from 1975 to 2000, net energy demand grows at only 1.8 percent per year in the FOSSIL Business-as-Usual (BAU) projection, and 0.9 percent per year with the Accelerated Coal and Conservation (ACC) policies.

Market Share of Demand

The demand market shares for each fuel (oil, gas, electricity, and coal) in FOSSIL change over time in response to changes in their prices, their availability, and their convenience. The causal determinants of energy demand are indicated in Figure B-8. The arrows of the figure trace out a simplified picture of the feedback structure through which the price, availability, and convenience of each fuel affect that fuel's market share. Changes in fuel

B-13

FIGURE B-6: DYNAMIC MECHANISMS THAT CHANGE ENERGY DEMAND IN FOSSIL

FIGURE B-7: COMPARISON OF GNP AND DEMAND GROWTH IN FOSSIL

^a 1975 dollars

^b BAU (Business as Usual) and ACC (Accelerated Coal and Conservation) are two FOSSIL scenarios described in Chapter 4 of this report.

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FIGURE B-8: FOSSIL DEMAND SECTOR CAUSAL DIAGRAM

The diagrammatic conventions used in such causal loop diagrams are as follows:

An arrow indicates the causal influence of one element on another.

A plus sign indicates the influence is direct -- as the element at the tail of the arrow increases, the element at the head of the arrow also increases (or as the first decreases, the second also decreases).

A minus sign indicates an inverse relationship -- as the first element increases, the second decreases, and vice versa.

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market share affect the size of the slices of the demand pie in Figure B-6.

Changes in fuel prices (and fuel availability) can shift market shares significantly in FOSSILL. Given extreme economic incentives, it is possible within the model structure to capture as much as 70 percent of the end-use market (compared to its 1975 share of 11 percent) and coal to increase its share to 25 percent (compared to its 1975 share of 8 percent). As in the determination of the size of energy demand, the full effects of a price change on demand market shares are not felt for fifteen years, due to the time required to replace user capital equipment.

Fuel convenience has had an important historical impact on consumer demand for energy. Although coal has remained inexpensive relative to its fuel competitors, its market share has declined from 35 percent of net demand in 1950 to only 8 percent in 1975. Coal is dirty, difficult to transport, environmentally damaging, and plainly undesirable for most end uses. The historical shift away from direct coal use is explained almost entirely by its growing inconvenience. Conversely, electricity's market share has grown significantly over history, due in part to its declining relative price and its relative convenience as a fuel form. Convenience is modeled in FOSSILL as an income effect: as consumers become wealthier, they shift away from inconvenient fuels (coal) and toward more convenient fuels (electricity).

Figure B-9 shows the changes in demand market shares projected by FOSSILL. Oil and gas decrease their market share from over 80 percent in 1975 to near 60 percent in 2000. Gas's market share decreases particularly rapidly (from 33 percent to 20 percent in the BAU projection) because of the worsening shortage. Coal and electricity each increase their share of net demand, with electricity yielding the biggest gains (growing to 24 percent in 2000).

Intermediate Sector Demands

In addition to the fuel-specific net demands for energy generated by the demand sector, a number of intermediate energy demands are generated by the four energy supply sectors in FOSSILL. These demands represent the feedstock input needs of energy conversion facilities (electric utilities and synthetic coal conversion plants).

FIGURE B-9: FOSSIL DEMAND MARKET SHARE PROJECTIONS

Figure B-10 illustrates the intermediate sector demands generated in FOSSIL1. Fuel-specific intermediate demands add to end-use demands to determine the total demand for each energy form. Intermediate energy demands can be substantial: coal demanded by electric utilities, for example, was almost 60 percent of total coal demand in 1975 (USDI 1976, p.57). The total (net plus intermediate) demand for each fuel must be met from alternative fuel supply sources.

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FIGURE B-10: INTERMEDIATE SECTOR DEMANDS IN FOSSIL

IV. ENERGY SUPPLY

Each of the four energy supply sectors in FOSSIL represents an aggregate industry whose purpose is to satisfy the demand for one of the four basic fuels used in the United States economy (oil, gas, electricity, and coal). Although the energy products of and government restrictions on each industry are different, the four industries share certain common structural properties. Each industry must finance new capital investment, allocate the investment to alternative energy sources, and convert the capital, labor, and resource inputs it has accumulated into a finished energy product. The following sections describe the generic industry financing and production structures used in the FOSSIL model.

Energy Financing

Because capital is the major factor of production in the energy industries, the financing decision--the generation and allocation of new funds--is the major determinant of future production levels for each industry. Figure B-11 illustrates the general financing structure used in each of the FOSSIL production sectors. Industry financing is divided in the diagram between sources and uses of funds.* Funds may be generated from either internal sources (net income and non-cash charges) or external sources (debt and equity) in FOSSIL. Internal funds represent funds from operations--net income (revenues minus costs minus taxes) and non-cash charges (depreciation plus depletion plus amortization expenses). Both are calculated endogenously in FOSSIL. Net income is a volatile stream of funds that depends on the profitability of current operations. Non-cash charges are a steadier source of funds, typically calculated as a fixed percentage of the capital stock.

External financing (through debt and stock issues) can supplement internally-generated funds in times of increased financial need. The amount of external financing available is tied to the financial health of the industry, measured by the average industry return on investment (ROI)

*Excellent references for energy financing concepts and data are Hass, Mitchell, and Stone 1974, and Chase 1974.

FIGURE B-11: FOSSIL FINANCING STRUCTURE

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in FOSSIL1. If the industry has a history of high rates of return, the debt capacity of the industry is expanded.

The use of funds (shown in the bottom half of Figure B-11) in each sector is determined by an allocator mechanism which divides the available capital between the various production alternatives. (The number of these alternatives varies from sector to sector.) The allocator weighs the marginal ROI's for each alternative, shifting investment as the marginal cost, capital productivity, and market price of each production process affect that alternative's marginal ROI. The production process with the highest ROI gets the greatest proportion of capital investment funds.

Figure B-12 illustrates the source and use of funds for a group of petroleum companies in 1974. The total funds invested in fixed assets are normally less than the sum of internal and external funds available, since some funds are typically allocated to dividends, debt repayment, increases in working capital, or are diverted to more profitable non-industry investments. The fraction of funds allocated to fixed capital expenditures can vary in the FOSSIL1 model, depending on the profitability of new investments.

The amount of internal and external investment funds available to an industry is a major determinant of its future ability to expand production. When funds are plentiful, new additions to production capacity can keep in step with growing demand. Unfortunately, financing has not always been sufficient, as in the case of the domestic oil and gas industries over the last decade. The combined effects of the regulation of oil and gas prices and the rapid rise in domestic exploration and development costs have decreased the profitability of new oil and gas investment. Domestic oil and gas production has consequently been declining since the early 1970's.

Energy Production Functions

The production capabilities of each of the energy supply options is determined by a dynamic production function in FOSSIL1. The production functions relate some or all of three factors of production--capital, labor, and resources--to the production capacity of each specific fuel type. Figure B-13 illustrates the variety of production functions included in the FOSSIL1 model. The production functions can be categorized into two types: primary energy production and energy conversion.

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FIGURE B-12: SOURCE AND USE
OF PETROLEUM INDUSTRY FUNDS IN 1974

Source: Chan 1974, p. 16.

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FIGURE B-13: FOSSIL PRODUCTION FUNCTIONS

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The production of primary energy assumes that energy is extracted from a finite and ultimately depletable resource base; this implies that energy production is resource-limited over the long term. Production capacity, for extraction processes, is therefore a function of resources, physical capital, and, in the case of underground coal, labor availability. In the case of energy conversion technologies, the energy feedstock is produced in another fuel sector of the model (outside of its immediate boundary). Production capacity of a conversion technology is therefore limited by the availability of physical capital (and only indirectly by resources through feedstock availability).

Because of its central importance to the energy transition problem, the dynamics of energy production are modeled in some detail in FOSSIL. As an example, Figure B-14 illustrates the conventional oil production structure. To model the depletion of oil, FOSSIL makes the distinction between undiscovered resources and proven reserves.* Oil resources represent the total inventory of geologic deposits, and can only decrease through time. Reserves, however, may either increase or decrease over time, depending on the relative rates of discovery (including new additions, extensions, and revisions) and production. The level of reserves determines the maximum production capacity of conventional oil in FOSSIL, for reserves cannot be drained below a minimum reserve/production ratio (typically eight to ten years), due to the limitations of current oil recovery technologies and reservoir characteristics (NPC 1972, p.67). The future behavior of reserves (and thus conventional oil production capacity) will be determined primarily by the rate of discovery of new oil reserves.

Oil discoveries are dependent on two factors in FOSSIL: capital investments in new drilling activity and resource depletion. These factors tend to move discoveries in opposite directions: capital accumulation tends to increase discoveries, while resource depletion tends to decrease discoveries through a decline in capital productivity (measured by annual production in quads per dollar of fixed capital investment). Capital productivity declines over time through a decrease in returns to drilling (measured in discoveries per foot drilled). Figure B-15 illustrates the dramatic drop in returns to drilling for the United States oil industry. Discoveries per foot are projected to decrease further in the future as oil resources are depleted to their minimum recoverable levels.

*Resources are supplies which are hypothesized to exist, but which have not been proven to exist through exploratory drilling. Reserves have been demonstrated to exist through the drilling and capping of wells. Unlike oil and gas, resources and reserves are aggregated into one stock for coal and uranium, since the major cost of production for the latter fuels is incurred in extraction, not exploration and development.

FIGURE B-14: CONVENTIONAL OIL PRODUCTION STRUCTURE

FIGURE B-15: RETURNS TO DRILLING
FOR THE U.S. PETROLEUM INDUSTRY

Source: Hubbert 1972, p. 20.

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V. SUPPLY/DEMAND MECHANISMS

Figure B-16 shows how the supply/demand balancing structure included in FOSSILL determines the quantity produced and the price of each fuel. The structure shown in Figure B-16 is a dynamic counterpart to the static microeconomic supply/demand analysis. (See, for example, Samuelson 1970, p.357.)

In the FOSSILL model, adjustments in supply and demand happen continuously in response to changes in both the price and availability of fuels. Yet at any one instant in time, total supply and demand are fixed. These elements interact in the supply/demand "marketplace" shown in Figure B-16 to determine quantity and price. This information then passes to both the producing and consuming sectors of FOSSILL to determine future demand (through consumer choice decisions) and production capacity (through investment decisions). In the short term, supply can be adjusted to meet demand by adjusting the utilization of existing production capacity. In the long term, capacity itself is adjusted through the price mechanism.

Quantity Produced

The FOSSILL structure assumes that when demand is at or below normal utilization factors (80 percent for most industries), producers will absorb minor fluctuations in demand simply by adjusting capacity utilization. Yet when demand grows faster than supply, the possibility of a shortage exists. Producers are hard-pressed to meet demand, and operating costs rise rapidly. Eventually a point is reached where facilities are operating at their maximum output, above which a capacity shortage occurs. If this point is reached, the resulting fuel shortage will trigger the model to increase imports (in the case of oil and gas) and to shift to other fuel forms through interfuel substitution.

Price

The FOSSILL structure calculates price as the direct sum of costs and profits (Figures B-16 and B-17.) Costs

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FIGURE D-16: SUPPLY/DEMAND MECHANISM IN FOSSIL

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FIGURE B-17: COSTS AND PRICES IN FOSSIL

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may be fixed or may vary as a function of both technology and the extent of depletion. Profits may be regulated (as in the oil, gas, and electric utility industries) or unregulated. The regulated profit margin is set to allow a particular maximum return on investment (ROI), based on statutory guidelines. Unregulated profit margins fluctuate in response to changing supply/demand market forces. When supply and demand are balanced, prices are set in the model to return a normal, industry-average ROI (eight to twelve percent annually, depending on the industry).

Imbalances in supply and demand can have a major impact on price. As shown in Figure B-17, these imbalances can cause the ROI to range along the horizontal scale, producing potentially wide variations in price. The capital intensity of the supply technology is also important, for prices can vary by as much as a factor of two among capital-intensive technologies (such as synthetic fuels). Taxes, which increase along with profits, add to the costs which are passed on to consumers. These three factors--supply/demand imbalance (which affects unregulated ROI), capital intensity, and taxes--interact dynamically to determine the price of each industry fuel in FOSSILL.

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VI. FOSSILL PARAMETERS

The United States energy system works within certain constraints or parameters, which have been identified and approximated in FOSSILL. These parameters are mathematical estimates of key factors in the production and demand processes, a sample of which have been selected to demonstrate the assumptions made in the FOSSILL model.

Energy Demand Elasticities

The responsiveness of energy demand to changes in consumer income or fuel price is often measured by a number representing its elasticity. (For a general discussion of elasticity, see Samuelson 1970, pp.359-64.) Figures B-18a and b illustrate the various energy demand elasticities assumed in FOSSILL. The top set of elasticities indicates the long-term responsiveness of total demand to changes in income and energy price; the numbers .9 (income) and -.28 (price) measure the percentage change in final demand caused by a 1 percent change in income and price. For example, a price elasticity of -.28 implies that a 100 percent increase in energy prices would decrease energy demand by 28 percent (if all other variables remained constant).

Figure B-18b shows that the market share of coal, electricity, gas, and oil are determined in the model by (1) a "convenience" effect (a GNP-induced shift in fuel choice) and (2) relative changes in energy prices. In FOSSILL, the convenience of using oil and gas as fuels is chosen as a reference point. Electricity is assumed to be more convenient than oil and gas, and coal less convenient. As incomes rise, consumers shift to the more convenient fuel. Hence on the left-hand "convenience" side, Figure B-18b shows that as GNP increases, the market share of coal drops and the market share of electricity rises. (There is no convenience effect for gas, for oil and gas are assumed equally convenient). On the right-hand "price" side, price increases in coal and electricity (again, relative to oil and gas) lead to decreases in their market shares. The gas price effect is shown relative to oil price.

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FIGURE B-18: FOSSIL ENERGY DEMAND ELASTICITIES

Sources: Net demand elasticities are derived from historical regression, and MIT, Cornell, and FEA estimates. Historical data regions for market shares are shown as heavy lines. Market saturation points (extreme values of market share tables) are derived from engineering estimates; 70% maximum for electricity; 25% maximum for gas; 10% maximum and 20% minimum for oil and gas (except for gas).

Each of the market-share elasticities is nonlinear, due to market saturation effects. For example, only 70 percent of the economy's end-use devices could shift to electricity, even under extreme price and convenience incentives. The remaining 30 percent represents non-substitutable uses of other fuels.

Resource Supply Estimates

To determine the availability of a resource, one must answer two questions: how big is the resource base, and what is the extraction cost? Figure B-19 illustrates the resource estimates used in FOSSILL. Coal is clearly our most abundant depletable resource. United States coal resources are actually greater than the total foreign oil and gas resource stocks. Yet much of this coal is expensive to extract and high in sulfur content. The most attractive coal resource option--low-sulfur surface-minable coal--is quite limited in supply.

Figure B-20 illustrates the resource supply curves embodied in the FOSSILL structure.* Our energy system is currently operating on the low-cost ends of the domestic oil and gas supply curves. As costs rise, the energy system tries to "jump" to resources with lower production costs (for example, coal or imported crude) if the fuels are substitutable. Yet because of non-economic restrictions (end-use technology designs, potential environmental damage, political considerations), the shift to low-cost resources is slow and incomplete. The energy system is left with no cheap alternative and must therefore deplete the remaining, more expensive oil and gas resources, or shift to high-priced substitutes such as syncrude or shale oil.

Cost of Conversion Technologies

Figure B-21 shows the costs of the energy conversion technologies (electricity and synthetic fuels) incorporated into FOSSILL. Perhaps the most remarkable fact about energy conversion is its expense--the electricity options (excluding solar) require a selling price of nine to twelve dollars per million Btu's (delivered electricity). The synthetic fuels are similarly high-priced at three to five

*The model structure actually includes a functional relationship between resources remaining and capital productivity.

FIGURE B-19: FOSSIL RESOURCE ESTIMATES

RESOURCE CATEGORY	RECOVERABLE RESOURCES
	AS OF 1975 (quads)
OIL (INCLUDING LIQUIDS)	800
TERTIARY RECOVERY	394
SHALE OIL	5,800
FOREIGN OIL	9,500
GAS	775
ENHANCED GAS	250
FOREIGN GAS	5,200
LOW-SULFUR SURFACE COAL	800
LOW-SULFUR UNDERGROUND COAL	4,000
HIGH-SULFUR SURFACE COAL	1,600
HIGH-SULFUR UNDERGROUND COAL	11,000
URANIUM (\$30/lb U_3O_8)	1,800 ^a

^a Assumes 33% conversion efficiency

Sources: Conventional oil and gas resource estimates are a consensus of NAS 1975, Hubbert 1974, and USGS 1975 (95% probability) estimates. Coal resource estimates from USBM 1971 and USGS 1973. Other resource estimates from ERDA 77-1.

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FIGURE B-20: REPRESENTATIVE SET OF RESOURCE SUPPLY CURVES
EMBODIED IN FOSSIL

Source: Oil and gas supply curves are derived from returns to drilling data in Hubbert 1974. Shale oil supply curves from FEA Oil Shale 1974. Coal supply curves are derived from U.S. Bureau of Mines Circulars 8535 and 8531, USBM 1974, and Zimmerman 1975.

FIGURE B-21: COSTS OF CONVERSION TECHNOLOGIES

ELECTRICITY		
FACILITY	CAPITAL COST (\$/kw)*	IMPLIED ELECTRICITY SELLING PRICE (\$/million Btu's)
OIL AND GAS	290	10.60
STANDARD COAL	355	10.30
COAL WITH SCRUBBERS	445	10.70
FLUIDIZED-BED COAL	400	9.50
LWR	585	11.20
BREEDER	690	11.10
SOLAR	1275	50.00

*1975 dollars

SYNTHETIC FUELS				
	PLANT COST ^a		IMPLIED SELLING PRICE	
	(millions) ^b		(\$/million Btu's)	
	1st generation technologies ^c	2nd generation technologies ^d	1st gen.	2nd gen.
SHALE OIL	970	500	3.25	2.00
COAL LIQUIDS	1000	900	4.55	4.25
LOW-BTU GAS	750	600	3.75	3.20
HIGH-BTU GAS	1000	900	4.80	4.30

^a10⁹ Btu/day rated output^b1975 dollars^cavailable today^dadvanced processes under development

Selling prices of electricity based on utility pricing (12%/year allowed ROI). Selling prices of synfuels based on 15%/year ROI (Discounted Cash Flow pricing method). All feedstock prices are variable in FOSSIL. The following prices were assumed as representative: oil and gas - \$1.50/million Btu's; coal - \$.75/million Btu's; low-sulfur coal - \$1.00/million Btu's; uranium fuel - \$.60/million Btu's.

Source: ERDA 77-1

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dollars per million Btu's for the average consumer. From this perspective, even the second-generation synthetic conversion technologies, with their increased efficiencies and reduced capital costs, are an expensive option.

Delays

The FOSSIL model includes a number of structures that introduce delays in the response of the energy system to outside influences. As shown in Figure B-22 the demand sector requires a full fifteen years to turn over its capital (in order to move toward more efficient end-use technologies) in response to an energy price increase. External financing of new investment tends to respond to a five-year history of a firm's financial health. The planning and construction of new energy supply facilities requires three to ten years. Once constructed, facilities are not normally replaced until fully depreciated--and energy capital lifetimes are up to 35 years in length. These delays combine to create the considerable inertia exhibited by the energy system, making it difficult for policymakers to alter the course of our energy future.

Financial Ratios

Although the basic structures of the four financial subsectors of FOSSIL are similar, each has been parameterized with financial ratios characteristic of the individual industry (Figure B-23). The aggregate energy industry has been fairly typical of total business, financing about 40 percent of its new investment externally over its history (see Hass, Mitchell, and Stone 1974, p.108). Electric utilities provide the exception: they tend to operate with lower profits, yet have financed over 60 percent of their new investment from outside sources.

Many of the financial ratios reported in Figure B-23 actually change in the FOSSIL model with the financial health of each industry. For example, Figure B-23 illustrates only the target return on investments for each industry--the actual ROI depends on the dynamics of production costs, supply/demand balances, and any regulatory procedures that may be enforced. External financing (determined by the external/internal financing ratio) is also a variable in FOSSIL. As the industry's ROI varies, its ability to attract external funds is affected. For example, if the energy industries earn greater than their target ROI's, they can increase their external/internal financing ratios above the norms shown in Figure B-23 in the model. As will be shown in the next section, the financial health of the energy industry can be greatly affected by government policy.

FIGURE B-22: SELECTED MATERIAL AND INFORMATION DELAYS IN FOSSIL

DELAY STRUCTURE	LENGTH (YEARS)
DEMAND ADJUSTMENT (END-USE CAPITAL LIFETIME)	15
FINANCING OF INVESTMENT	5
OIL AND GAS DISCOVERY	3
SYNTHETIC OIL AND GAS FACILITIES CONSTRUCTION	8
NUCLEAR PLANT CONSTRUCTION	10
OPENING A NEW SURFACE COAL MINE	3
OPENING A NEW UNDERGROUND COAL MINE	5
LIFETIME OF OIL AND GAS DRILLING EQUIPMENT	7
SYNFUELS PLANT LIFETIME	20
ELECTRICITY GENERATION PLANT LIFETIME	35

FIGURE B-23: FINANCIAL RATIOS IN FOSSIL

RATIO	OIL	GAS	ELECTRICITY	COAL
DEPRECIATION/TOTAL CAPITAL	.11	.11	.03	.07
TAX RATE	.5	.5	.25	.50
DIVIDEND PAYOUT	.5	.5	.66	.25
NORMAL EXTERNAL/INTERNAL FINANCING RATIO	30/70	30/70	50/40	40/60
TARGET ROI (%/year)	12	12	8 ^a	12

^abefore interest and taxes

Sources: Oil and gas data from Chase 1974; electricity data from EEI 1974; coal data from USBM 1976.

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Mr. DINGELL. The committee thanks you.

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ENERGY SUPPLIES, DEMANDS, AND
PRICES FOR THE U.S. ECONOMY IN 1985

by

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*We now know who pays and how much,
we next need to find out who gets
and why.*

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HIGHLIGHTS OF "ENERGY SUPPLIES,
DEMANDS, AND PRICES FOR THE U.S. ECONOMY IN 1985"

The University of Houston has developed a reliable, consistent computer model which provides an economic framework to show the effects of government policies on energy prices, production, use, and costs. This economic framework was used to evaluate three different alternatives for United States energy policy: (1) Modified Price Regulation, (2) Complete Price Deregulation, and (3) Business-As-Usual. As modeled, Modified Price Regulation reflects the salient pricing, taxing, and environmental recommendations of President Carter's Program; and Complete Price Deregulation reflects the fundamental pricing recommendations of the Texas Governor's Energy Advisory Council plus windfall profit taxes on old oil production.

In the Modified Price Regulation Case, higher regulated prices are allowed for new natural gas; new crude oil prices are allowed to rise to the current world price; excise taxes are imposed on industry, electric utilities, and gasoline; and stack gas scrubbers are required on all new electric power plants and industrial steam boilers. In the Complete Price Deregulation Case, crude oil and new gas prices are allowed to rise to what the market will bear, windfall profit taxes are imposed, and water and air pollutants must meet EPA's promulgated effluent standards. In the Business-As-Usual case, natural gas and crude oil prices are regulated as at present, no new taxes are imposed, and EPA's promulgated effluent standards are met. All evaluations are made for 1985; and all monetary units are expressed in 1975 dollars.

The major points of the study show the following consequences for the Modified Price Regulation Case in comparison to the Complete Price Deregulation Case:

1. Economic costs of fossil energy in 1985 are \$212 higher per person in the Modified Price Regulation Case than in the Complete Price Deregulation Case largely because of hidden costs and taxes.
2. Consumer Costs of electricity from new coal plants are 18 to 20 percent higher (4.0 to 4.6 mills per kWh) in the Modified Price Regulation Case than in the Complete Price Deregulation because uneconomic sulfur control technology must be used.
3. Higher regulated prices of natural gas will give cheap gas to those final consumers who can obtain gas at the regulated prices but not to those final consumers who must substitute purchases of imported oil and gas products at high import prices.
4. Gasoline use and oil imports will only be decreased significantly by full imposition of the proposed gasoline excise taxes.
5. Universal use of stack gas scrubbers, as recommended by President Carter, increases the national cost of electricity, discourages growth of coal production, and shifts the production of coal from the West to the East.
6. Excise taxes on electric utility, petroleum refining, and basic chemical industry uses of oil products and natural gas are not needed at the prices proposed by President Carter to phase out the use of oil and gas products in the firing of boilers in these industries.

ENERGY SUPPLIES, DEMANDS, AND
PRICES FOR THE U.S. ECONOMY IN 1985

1. Introduction

Since the Arab Oil Embargo in the fall of 1973, the Industry Studies Program of the University of Houston has developed a comprehensive economic modeling capability for the fossil energy sector of the United States economy. This modeling capability includes (1) detailed process economic models for the electric power, petroleum refining, and basic chemicals industries, (2) price responsive supply models for crude oil, natural gas, and coal, and (3) economic demands for gasoline, electricity, natural gas, fuel oils, kerosene, and coal. Interactive use of the industry models, the economic supplies, and the product demands gives an equilibrium solution in prices and quantities for the fossil energy sector of the national economy. This equilibrium solution shows how the raw energy resource and energy endproduct markets will adjust to a wide range of energy, environment and economic policies before policy is changed.

The primary purpose of developing this industry modeling capability is to show how cost-conscious managers in the nation's petroleum refining, electric power, and basic chemicals industries will respond to major changes in resource availabilities, effluent standards, and product requirements before these availabilities, standards, or requirements are regulated by government policy. Accomplishing this objective requires a synthesis of technical information into a mathematical economic framework to evaluate the engineering cost, resource use, and technical configuration consequences of policy decisions

and economic considerations. Evaluations are made by limiting or not limiting (1) the availability of any scarce energy, capital, water, or raw material input, and (2) the discharge of any major water, air, or solid waste pollutant. Also, evaluations are made by increasing or decreasing (a) the price of any resource input, (b) the price of any resource output, or (c) the possible effluent tax on any major pollutant; see Calloway and Thompson (1976) and Thompson et al. (1976a, 1977a) for descriptions of industry models.

One of the fundamental uses of this economic framework is to show how the responses of industry managers to different resource, environmental, and consumer policies will affect production costs, resource prices, energy use, and capital requirements. Attaining this use requires economic supply functions for natural resources to evaluate the increasing marginal product costs of restrictive discharge standards, reduced depletion allowances, decreased tax incentives, and wellhead price controls; see Kim and Thompson (1976) for a description of supply models for crude oil and natural gas, and see Appendix II for a description of the supply model for coal.

Another fundamental use of this economic framework is to show how the responses of final consumers to these higher supply costs will feed back to industry managers and resource producers to modify the product costs paid by consumers, the resource mix used by industry, and the wellhead prices received by resource producers. Attaining this use requires economic demand functions for important endproducts to evaluate the sensitivities of consumer market baskets to efforts by industry to pass through higher marginal costs of production; see Thompson et al. (1976b, 1977b) for a description of how the supply, industry and demand models are interfaced.

Users of this economic modeling capability are the Texas Governor's Energy Advisory Council, the Wharton Econometrics Forecasting Associates, Inc., the National Commission on Water Quality, the Federal Energy Administration (FEA), and the International Institute of Applied Systems Analysis (IIASA). The Advisory Council has continually used the models since 1974 to forecast (i) the production of crude oil, natural gas, and coal, (ii) the use of important energy endproducts (electricity, gasoline, kerosene, fuel oils, natural gas, and coal), and (iii) the prices of both raw energy resource inputs and finished energy endproducts; see Thompson *et al.* (1975b, 1976c). The Wharton Group has effectively built the electric power model into their long-run industry and economy forecasting model; see Griffin (1977). The National Commission on Water Quality used the models to evaluate the economic impact on the Houston/Galveston Region of federally promulgated wastewater effluent standards; see Thompson *et al.* (1975a). FEA plans to use the industry models as the fundamental petroleum refining/basic chemical industries components of the Project Independence Evaluation System. IIASA plans to use the models for economic evaluations in countries of its 17 national member organizations.

2. Purpose of the Study

The primary purpose of this study is to use the modeling capability of the Industry Studies Program to answer the following questions for the fossil energy sector of the United States economy in 1985:

- How will a modified energy price regulation policy (Modified Price Regulation) affect U. S. energy costs, foreign exchange payments, domestic energy prices, fossil energy production, electric power generation, industry capital requirements, and sulfur dioxide discharges?

- How will the consequences of a modified energy price regulation policy compare with the consequences of a deregulated energy pricing policy (Complete Price Deregulation)?
- How will the consequences of a Modified Price Regulation and Complete Price Deregulation policies compare with the consequences of a Business-As-Usual policy?

As modeled, the Modified Price Regulation option reflects the most salient pricing, taxing, and environmental recommendations in President Carter's Energy Program; see Appendix for delineation. The Complete Price Deregulation option reflects market-clearing prices for crude oil and natural gas, a windfall profits tax on old domestic oil production, and implementation of EPA's promulgated effluent standards. The Business-As-Usual option basically reflects continuation of present government energy pricing and environmental control policies.

3. Specifications and Assumptions

The following specifications and assumptions were made in the modeling to answer the three basic questions for 1985 (1975 dollars are used throughout):

- Estimates of domestic supplies of new crude oil and natural gas assume no depletion allowance, continued deductions of intangible and dryhole drilling costs, and a future finding rate reflecting the rate of change in cumulative finds vs. cumulative exploratory drilling since 1962.
- Capacities of old fossil steam electric power plants were based on National Electric Reliability Council estimates (1975).
- Ranges of retirement rates for old electric power plants between 1975 and 1985 were from 10 to 30 percent for coal, oil, and gas-fired

plants and from 0 to 5 percent for combined-cycle plants.

- Annual supplies of electricity from nuclear generation are 372.7 billion kilowatt hours for the East Coast Region and 368.3 billion kilowatt hours for the rest of the country.
- Imports of crude oil and residual fuel oil are available, as needed, at prices of \$13 per barrel; limited imports (up to 3 trillion cubic feet) of liquified natural gas are available at \$2.50 per 1000 cubic feet.
- Use of oil products and natural gas in all new base-load fossil-fueled electric power plants and new industrial steam boilers is prohibited in all three cases.
- Cogeneration of electricity by the process industries for sale into the grid of electric utilities is allowed in all three cases.
- Sulfur content of oil sold to residential/commercial sectors must meet new source air emission standards. Sulfur content of coal sold to these sectors must be equivalent to no more than 1.25 times the new source sulfur oxide standards. Use of best available technology is required for all major wastewater effluents. Air emissions from new plants must meet new source standards as promulgated by EPA in the Complete Price Deregulation (CPD) and Business As-Usual (BAU) Cases. In the Modified Price Regulation (MPR) Case, stack gas scrubbers are required on all new fossil-fueled electric power plants and new coal-fired industrial steam boilers. In all cases old plants must burn oil having 1% sulfur or less, and old coal-fired plants must not emit more than one and one-half times as much sulfur oxides as allowed by new source standards.
- The Implicit Gross National Product Price Deflator is used to make constant dollar adjustments.

- Domestic supplies of crude oil and natural gas are determined in response to the following price conditions:

	Modified Price Regulation <u>MPR</u>	Complete Price Deregulation <u>CPD</u>	Business-As- Usual <u>BAU</u>
	(1975 dollars)		
Old Natural Gas	\$.80/Mcf	\$.80/Mcf	\$.80/Mcf
New Natural Gas	\$1.61/Mcf	Market-Clearing	\$1.42/Mcf
Crude Oil from pre '74 Reserves(L.Tier)	\$4.84/bbl	Market-Clearing	\$4.84/bbl
Crude Oil from '74- '77 Reserves(U.Tier)	\$10.40/bbl	Market-Clearing	\$10.40/bbl
Crude Oil from New Reserves(after '77)	\$13.78/bbl	Market-Clearing	\$10.40/bbl

- Imposition of the following taxes are assumed for the MPR Case (1975\$):

	<u>Transportation</u>	<u>Industry</u>	<u>Electric Utilities</u>
Oil products	-	\$.46/MMBtu's	\$.20/MMBtu's
Natural Gas	-	\$1.54/MMBtu's	\$1.24/MMBtu's
Gasoline	\$14.70/bbl.	-	-

The taxes imposed on industry are applied only to petroleum hydrocarbons used as fuels. Chemical feedstocks are exempt from taxation, as are all synthetic fuels derived from coal.

- Real rate of growth in the economy from 1975 through 1985 will average 3 percent per year (1.2% for population and 1.8% for real per-capita income).
- FEA's demand model (1976) is used basically to reflect (1) the final consumer's response to prices of important energy products (gasoline, electricity, natural gas, fuel oils, kerosene, and coal) and (2) the improved efficiencies of energy use resulting from anticipated adoption of new end use technology.

4. Results of the Modeling Evaluations for 1985

Fossil Energy Supplies, Demands, Prices and Imports. Comparison of the modeling results in Table 1 shows deregulated prices of new natural gas in the CPD Case will increase domestic production 1.63 Tcf (9.2%) from the level in the MPR Case (17.75Tcf). Gas production is .35 Tcf higher in the MPR Case than in the BAU Case, where interstate prices are limited to \$1.42 per 1,000 cubic feet. In the MPR Case, a small amount of liquefied natural gas (.01 Tcf) must be imported at a price of \$2.50 per Mcf to supply needed feedstock and fuel uses; however, total gas supplies from domestic and foreign sources are 12 percent less in 1985 than they were from domestic sources in 1975.

Domestic production of oil liquids in 1985 is virtually the same, according to the model, in the MPR and CPD Cases (4.66 vs. 4.67 billion barrels). This level of production is around 28 percent greater than the level of production in 1975. Imports of crude oil in the MPR Case are at the 1975 level (2.22 vs. 2.23 bil. bbls.). Crude oil imports are 13 to 18 percent higher in the CPD and BAU Cases than they were in 1975. Supplies of oil products used grow at the average rate of 1.7 percent per year in the MPR Case and at the average rate of 2.2 percent per year in the CPD Case.

Coal production in the CPD and BAU Cases is close to one billion short tons in 1985. This level of production is around 47 percent greater than the level in 1975 (640 mil. s. tons). Considerably less coal is produced in the MPR Case (809 mil. s. tons) than in the CPD and BAU Cases (940 and 950 mil. s. tons) because the uniform stack gas scrubber requirements increase electricity costs and decrease electricity use.

In terms of Btu's, less fossil energy is used in the MPK Case (74.70 quads) than in the CPD (79.42 quads) Case. Less oil products are used because of gasoline excise taxes; less natural gas is used because of low domestic production and high import prices; and less coal is used because of high electricity costs. Fossil energy use in the MPR Case grows at an average annual rate of only 1.2 percent from 1975 to 1985. This growth rate compares to the higher growth rate of 1.9 percent in the CPD Case. Both rates are below the President's 1985 goal of 2% growth in demand per year.

In the CPD Case, environmental standards for sulfur dioxide may be met by substituting low-sulfur coal use for high-sulfur coal use with stack-gas scrubbers. However, in the MPR Case, substitution of low-sulfur coal for high-sulfur coal is discouraged economically by the required use of stack-gas scrubbers on all new coal plants. The Carter Proposal increases the user costs of low-sulfur coal and expands the demand for high-sulfur coal. This policy would increase the production of high-sulfur coal on the East Coast (61 mil. s. tons) and in the Midwest (22 mil. s. tons) and decrease the production of low-sulfur coal in the Far West (218 mil. s. tons); see Table 2. High-sulfur coal producers reap a large price increase of \$4.53 per ton in the Midwest and \$3.25 per ton on the East Coast because of the government expanded demand for high-sulfur coal. Low-sulfur coal producers in the Far West suffer a significant price decrease of \$1.60 per ton because of the government increased supply cost to users of low-sulfur coal; see Table 3.

In analyzing the price and use of low-sulfur coal versus the price and use of high-sulfur coal, two points must be kept in mind: (1) Btu content of the Eastern (and Midwestern) coal is greater per ton than the Btu content of Western low-sulfur coal; and (2) the costs of transporting low-sulfur coal from the Western mines to the East Coast is approximately \$20 per ton. See Table 4 for Btu content of fossil energy.

The regulated price of natural gas at \$ 1.61 per Mcf (\$1.75 per Mcf in April 1977 dollars) in the MPR Case results in continued excess demand in the natural gas market. Unsatisfied users of natural gas are willing to pay \$2.34 per Mcf (wellhead) for an additional 1,000 cubic feet of gas. This shadow price of \$2.34 per Mcf in the MPR Case compares with a market-clearing price of \$2.29 per Mcf in the CPD Case. The marginal price of domestic crude oil exceeds the marginal price of imported crude oil because of a premium for low sulfur oil.

Because of the excise taxes on oil products in addition to the higher regulated prices of new oil, the Carter Energy Proposal decreases the use and imports of oil products. Foreign exchange payments are \$3.42 billion less in the MPR Case (\$29.05 billion) than in the CPD Case (\$32.47 billion). Deregulation of oil prices stabilizes imports at approximately their current level; see Table 5.

A noticeable feature of the import bill is how its composition changes between the CPD and MPR Cases. In the CPD Case, deregulation of oil and gas prices gives self-sufficiency in natural gas production; a relatively modest level of residual fuel oil imports (8.5% of import bill); and a relatively high level of crude oil imports (91.5% of import bill). However, in the MPR Case imports of crude oil for refining in this country decrease to 86.9 percent of the foreign exchange payments for imports. Imports of residual fuel oil increase to 13 percent of the import bill because less domestic refining to produce gasoline produces less residual fuel oil.

Fossil-Fueled Electric Utilities. The Carter Energy Proposal has a significant impact on the fossil-fueled electric utilities in the nation. In comparison to the CPD Case, 139 billion kilowatt hours less electricity is generated and used in the MPR Case. This decrease in use results from the much

higher generation costs in the new coal burning base load plants, where stack-gas scrubbers are uniformly required on all new plants. Foregoing the alternative to achieve EPA's new source standards for sulfur dioxide by substituting low-sulfur, clean coal for high-sulfur, dirty coal and stack-gas scrubbers increases the marginal costs of generating electricity 4.0 mills per kWh on the East Coast and 4.6 mills per kWh in the rest of the country. Capital requirements are less in the MPR Case than in the CPD Case because of "belt-tightening" by electricity users; see Tables 6 and 7.

The composition of the investment in new electric power plants (fossil-fueled) is noteworthy. In the CPD Case, all of the new plants are steam-electric plants; however, in the MPR Case, 61 percent of the new plants are coal gasification/combined cycle plants. Required use of stack-gas scrubbers creates incentives for introduction of this new technology.

Fossil Energy Sales, Cost, Economic Value, and Regulation Costs at Wellhead and Minemouth Level.

Increasing the regulated price of new oil and increasing the regulated price of new natural gas (interstate) increases the revenues received by domestic producers of oil and gas from \$56.8 billion in the BAU Case to \$69.1 billion in the MPR Case. See Table 8. Deregulating the prices of crude oil and new natural gas increases the revenues received by domestic producers of oil and gas from \$69.1 billion in the MPR Case to \$79.8 billion in the CPD Case. Revenues of domestic gas producers, who employ U. S. workers and invest in the U. S. economy, increase around \$10 billion. This modification in the regulation of new oil and gas prices does not affect very much the revenues received by all U. S. coal producers; but in combination with the universal stack-gas scrubber requirement for all new plants, it does affect significantly the regional composition of the revenues received by domestic coal producers. Revenues received by low-sulfur coal producers decrease from 83 percent of total coal revenues in the CPD and BAU Cases to 64 percent of these revenues in the MPR Case.

Revenues received by the domestic producers of raw fossil energy represent the sales costs, excluding taxes, of raw fossil energy at the wellhead and minemouth level. Sales costs represent the open transaction costs of producing fossil energy for those users who can buy fossil energy at the regulated prices; however, sales costs fail to take into account the hidden economic costs of those users who must substitute purchases of higher priced products. Two types of hidden costs are present in the BAU and MPR Cases. Both new oil and gas are regulated at prices below the market-clearing prices in the BAU Case. Clearly, new gas is regulated at a price below the market-clearing level in the MPR Case, while new oil is regulated at the current world price.

With price regulation, users must substitute imported oil products at

high world oil prices for unavailable domestic production, which would be produced at prices above the regulated prices but is not because of the domestic price regulation. This price regulation imposes a cost on society; a measure of this regulation cost is the difference between the economic value of domestic raw fossil energy less the sales costs of the domestic raw fossil energy at the wellhead and minemouth level; see Table 9.

Regulation of both oil and gas prices at current levels imposes a hidden cost on U. S. citizens of \$33.0 billion in 1985. The Carter Program, as modeled, decreases the magnitude of this hidden cost from \$33 billion in the BAU Case to \$23.6 in the MPR Case. Higher regulated prices of new oil and new gas will save the public at least \$9.4 billion; however, deregulating new gas and new oil would save U. S. citizens another \$8.1 billion in raw fossil energy costs. Continued regulation of oil and gas prices at current levels, which seems to take advantage of producers, will actually cost users of fossil energy \$17.5 billion in 1985. Actually, costs to society will be several fold greater than the costs to the fossil energy sector alone because of the ripple effects through all sectors of the economy.

Because the economy will be operating at different levels of fossil energy production in the three cases, the economic cost of regulation per million Btu's is an improved measure of the hidden cost of price regulation; see Table 10. Higher regulated prices of new oil and new gas in contrast to continued regulation of oil and gas prices at current levels will save U. S. citizens at least 14.4 cents in hidden costs at the wellhead and minemouth level for every million Btu of fossil energy used in 1985. Deregulation of prices (new oil and new gas) and clean fuel substitutions instead of continued regulation of prices and forced use of stack-gas scrubbers will save U. S. citizens another 14.6 cents in hidden costs at the wellhead and minemouth level for every million

Btu of fossil energy used in 1985.

With a 65 quad level of domestic fossil energy production and use, the nation will sacrifice \$18.9 billion in hidden costs in 1985 at the wellhead and minemouth level if it continues to regulate the prices of oil and gas as at present. This \$18.9 billion represents lost economic opportunity to the fossil energy sector of the U.S. economy because of the hidden costs being imposed on U.S. citizens by over zealous regulators in policy-making positions.

Proposed Petroleum Taxes and Economic Costs of Energy at Wholesale Level.

A striking feature of the Carter Program is the magnitude of the new taxes recommended at the conversion level, where the raw crude oil, natural gas, and coal are transformed from fuel and feedstocks into useable endproducts, and at the final consumer level, where endproducts are transformed into desired services; see Table 11. A total of \$54.7 billion of new taxes in the Carter Program will be imposed on the conversion industries (\$19.7 billion) and final consumers of gasoline (\$35 billion). This tax will fall heavily on people living in the West South Central States (Texas, Oklahoma, Arkansas, and Louisiana). In 1974, 62 percent of the natural gas used in electric power generation in the nation was used in the West South Central States; and 47 percent of the natural gas used in industry was used in the West South Central States. If this pattern of use continues in 1985, electric utilities in the West South Central States will pay \$2.34 billion of the proposed excise tax on natural gas use in electricity generation; and process industries in the West South Central States will pay \$5.57 billion of the proposed excise tax on natural gas use in industry. As is well-known, people living in Texas will pay a disproportionate share of the gasoline tax because of the state's geographical size.

The sum of the oil equalization tax at the producer level and the excise taxes at the conversion industry and final consumer levels is \$70.11 billion in 1985. These new taxes virtually equal the sales costs received by domestic producers of oil and gas at the wellhead and minemouth levels in the MPR Case.

An alternative way to compare the economic costs of the MPR, CPD, and BAU Cases is to add the value of resources estimated by the model (at marginal prices), the costs of oil imports, and the new taxes of each case; see Table 12. This measure of economic costs shows that costs of fossil energy at the wholesale level, where distribution costs are ignored, would be the highest in the MPR Case (\$231 billion) and the lowest in the BAU Case (\$160 billion).

The deregulation of prices in the CPD Case gives a higher level of domestic industrial activity (\$144 billion) than the higher regulated prices of new oil and new gas in the MPR Case (\$132 billion). However, the higher regulated prices of the Carter Program give considerably more domestic industrial activity and less oil imports than a BAU Program, as at present.

Economic costs of fossil energy at the wholesale level are by far the highest in the MPR Case largely because of the excise taxes on gasoline, electric utilities, and industry. The excise taxes of the Carter Program are not needed to discourage the use of oil and gas to fire boilers in industry and electricity generation at the recommended prices for oil and gas. All of the process industries modeled use coal to fire boilers; and old oil and gas electric power plants are retired at the maximum possible rate. However, the gasoline excise taxes of the Carter Program are necessary in the model to reduce gasoline use (7 percent) below the 1976 consumption level of 2.56 billion barrels. Fossil energy costs at the wholesale level are \$3.09 per million

Btu in the MPR Case and \$2.42 per million Btu in the CPD Case. As modeled the per person cost of fossil energy at the wholesale level in 1985 is \$212 greater in the MPR Case than in the CPD Case at 75 quads of use.

In summary, two of President Carter's six national goals for 1985 (reduced demand growth and increased coal production) can be attained in a much cheaper way than the way proposed by the President. Use of market prices and windfall profits taxes will reduce demand growth below 2 percent per year. This market forces alternative will come closer to attaining the President's coal production goal (increased production of 400 million tons per year from the current level) than the program he proposed. Full imposition of the proposed gasoline tax is necessary to make positive progress toward the gasoline consumption goal (10% reduction from the current level) and oil import goal (6 million barrels per day) of the President. Accomplishment of the two remaining goals (insulate 90% of the buildings and use solar energy in 2 1/2 million homes) can be added to any alternative program.

TABLE 1
 -UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
 FOSSIL ENERGY SUPPLIES AND DEMANDS FOR DIFFERENT
 ENERGY POLICY PROPOSALS, 1985

<u>Fossil Energy Source</u>	<u>1975</u> <u>Statistics</u>	<u>Policy Cases</u>		
		<u>Modified</u> <u>Price</u> <u>Regulation</u> <u>(MPR)</u>	<u>Complete</u> <u>Price</u> <u>Deregulation</u> <u>(CPD)</u>	<u>Business</u> <u>As</u> <u>Usual</u> <u>(BAU)</u>
Supplies				
Oil (billion barrels)				
Domestic ¹	3.65	4.66	4.67	4.52
Imported ²	<u>2.22</u>	<u>2.23</u>	<u>2.50</u>	<u>2.62</u>
Total oil	5.87	6.89	7.17	7.14
Natural Gas ³ (tril.cu.ft.)				
Domestic	20.1	17.75	19.38	17.40
Imported	<u>-</u>	<u>0.01</u>	<u>-</u>	<u>1.84</u>
Total gas	20.1	17.76	19.38	19.24
Coal (million short tons)	640	809	940	950
Demands (quadrillion Btu's)				
Oil		38.36	39.78	39.70
Natural Gas		18.33	20.00	19.85
Coal		<u>18.01</u>	<u>19.64</u>	<u>19.94</u>
Total Use	66.83	74.70	79.42	79.49

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1. Includes natural gas liquids
 2. Includes residual fuel oil
 3. Includes associated gas

TABLE 2
 -UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
 DOMESTIC ENERGY SUPPLIES FOR DIFFERENT ENERGY
 POLICY PROPOSALS, 1985

<u>Fuel Type and Supply</u>	<u>Policy Cases</u>		
	<u>Modified Price Regulation (MPR)</u>	<u>Complete Price Deregulation (CPD)</u>	<u>Business As Usual (BAU)</u>
Crude Oil (billion barrels)			
New Wells	2.67	2.61	2.54
Old Wells	<u>1.43</u>	<u>1.43</u>	<u>1.43</u>
Total	4.10	4.04	3.97
Natural Gas Liquids (billion barrels)			
New Wells	.34	.41	.33
Old Wells	<u>.22</u>	<u>.22</u>	<u>.22</u>
Total	.56	.63	.55
Natural Gas (trillion cubic feet)			
New Wells	10.66	12.29	10.31
Old Wells	<u>7.09</u>	<u>7.09</u>	<u>7.09</u>
Total	17.75	19.38	17.40
Coal (million short tons)			
Eastern High Sulfur	115	54	54
Eastern Low Sulfur	309	306	310
Midwestern High Sulfur	155	133	133
Western Low Sulfur	<u>230</u>	<u>448</u>	<u>452</u>
Total	809	941	950

TABLE 3
 -UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
 FOSSIL FUEL PRICES AT FINAL ITERATION OF MODEL
 FOR DIFFERENT ENERGY POLICY PROPOSALS, 1985

<u>Fossil Fuel Type and Price</u>	<u>Policy Cases</u>		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(1975 dollars)		
<u>New Oil Price (\$/bbl)</u>			
Input			
Domestic	13.78	13.78	10.40
Imported	13.00	13.00	13.00
Marginal			
Domestic	13.84	13.79	13.75
Imported	13.00	13.00	13.00
<u>New Gas Price (\$/s mcf)</u>			
Input	1.61	2.29	1.42
Marginal	2.34	2.29	2.35
<u>Coal Prices (\$/short ton)</u>			
Eastern High Sulfur	14.05	10.80	10.80
Eastern Low Sulfur	17.50	17.50	17.50
Midwestern High Sulfur	14.91	10.38	10.38
Western Low Sulfur	7.30	8.90	8.90

TABLE 4

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
BTU CONTENT OF DOMESTIC AND FOREIGN FOSSIL ENERGY
FOR DIFFERENT POLICY ALTERNATIVES, 1985

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
(quadrillion Btu)			
<u>Domestic Production</u>			
Oil Liquids	25.464	25.435	24.718
Natural Gas	18.318	19.996	17.957
Total Oil and Gas	43.782	45.431	42.675
Eastern High Sulfur	2.767	1.291	1.308
Eastern Low Sulfur	8.039	7.956	8.070
Midwest High Sulfur	3.346	2.866	2.866
Western Low Sulfur	3.862	7.523	7.594
Total Coal	18.014	19.636	19.838
Total Domestic Fossil	61.796	65.067	62.513
<u>Imports</u>			
Oil Products	12.898	14.340	14.983
Natural Gas	.011	-	1.896
Total Fossil Imports	12.909	14.340	16.879
Total Domestic and Foreign	74.705	79.407	79.392

TABLE 5

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
FOREIGN EXCHANGE PAYMENTS FOR DIFFERENT ENERGY
POLICY PROPOSALS, 1985

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
(billion 1975 dollars)			
Crude Oil	25.25	29.71	31.51
Residual Fuel Oil	3.77	2.76	2.48
Natural Gas	0.03	-	4.59
	29.05	32.47	38.58

TABLE 6

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
ELECTRICITY GENERATED, GENERATION COSTS, CAPITAL
REQUIREMENTS, AND SULFUR DISCHARGES FOR DIFFERENT
ENERGY POLICY PROPOSALS, 1985

	Policy Cases ¹		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
Electricity Generated (billion kWh)			
East Coast Region	1240	1293	1298
Rest of Country	2014	2100	2107
	<u>3254</u>	<u>3393</u>	<u>3405</u>
Electricity Generation Costs in Fossil Fueled Plants (billion 1975 dollars)			
East Coast Region	12.10	12.02	12.08
Rest of Country	16.86	16.42	16.51
	<u>28.96</u>	<u>28.44</u>	<u>28.59</u>
Capital Requirements for Fossil- Fueled Electric Power Plants, 1975- 1985 (billion 1975 dollars)			
East Coast Region	17.12	18.42	18.77
Rest of Country	25.33	26.79	27.24
	<u>42.45</u>	<u>44.61</u>	<u>46.01</u>
Sulfur Dioxide Discharges of Electric Power Plants (billion pounds)			
East Coast Region	8.56	10.08	10.13
Rest of Country	12.62	16.33	16.41
	<u>21.18</u>	<u>26.41</u>	<u>26.54</u>
Marginal Costs of Generating Electricity in Fossil Fueled Plants (Cents per kWh in 1975 dollars)			
East Coast Region	2.65	2.25	2.25
Rest of Country	2.73	2.27	2.27

1. East Coast Region is states east of Appalachian Mountains, and Rest of Country Region is states west of Appalachian Mountains.

TABLE 7
 -UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
 ELECTRIC POWER GENERATION FOR NEW AND OLD PLANTS
 BY FUEL TYPE FOR DIFFERENT ENERGY POLICY PROPOSALS,
 1985

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(billion kWh)		
<u>Old</u>			
Gas-Fired Steam Electric	358	358	358
Oil-Fired Steam Electric	331	331	331
Coal-Fired Steam Electric	858	858	858
Combined Cycle	15	15	15
Total Old	1562	1562	1562
<u>New</u>			
Coal-Fired Steam Electric	192	630	642
Coal Gasification/Combined Cycle	300	-	-
Total New	492	630	642
Nuclear	741	741	741
Hydro	460	460	460
Total	3254	3393	3405

TABLE 8
 -UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
 REVENUES RECEIVED BY DOMESTIC PRODUCERS OF OIL
 LIQUIDS, NATURAL GAS, AND FOUR TYPES OF COAL AT
 WELLHEAD AND MINEMOUTH PRICES, 1985

	Policy Cases ¹		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(billions 1975 dollars)		
<u>Oil and Gas</u>			
Oil Liquids	46.3	46.1	36.5
Natural Gas	22.8	33.7	20.3
Total Oil and Gas	69.1	79.8	56.8
<u>Coal</u>			
Eastern High Sulfur	1.62	0.58	0.59
Eastern Low Sulfur	5.41	5.36	5.43
Midwest High Sulfur	2.31	1.38	1.38
Western Low Sulfur	1.68	3.99	4.02
Total Coal	11.02	11.30	11.42
Total Oil, Gas & Coal	80.1	91.1	68.2

1. Revenues are calculated as follows: (1) In MPR Case, revenues reflect regulated prices for new gas, lower tier oil, and upper tier oil; and revenues reflect current world prices for new oil, as specified; (2) In CPD Case, revenues reflect market prices for new gas and new oil; revenues reflect market prices less windfall profit taxes for lower tier and upper tier oil; and (3) In BAU Case, revenues reflect regulated prices for oil and new gas.

TABLE 1

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
SALES COSTS, ECONOMIC VALUE, AND REGULATION COSTS
OF DOMESTIC RAW FOSSIL ENERGY PRODUCTION AT
WELLHEAD AND MINEMOUTH LEVEL, 1985.

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
(billion 1975 dollars)			
<u>Sales Cost of Domestic Raw Fossil Energy Production, as Received by Producers¹</u>			
Oil Liquids	46.3	46.1	36.5
Natural Gas	22.8	33.7	20.3
Coal	<u>11.0</u>	<u>11.3</u>	<u>11.4</u>
Total Sales Costs	80.1	91.1	68.2
<u>Economic Value of Domestic Raw Fossil Energy Production²</u>			
Oil Liquids	62.1	61.6	59.9
Natural Gas	30.6	33.7	29.9
Coal	<u>11.0</u>	<u>11.3</u>	<u>11.4</u>
Total Economic Value	103.7	106.6	101.2
<u>Economic Cost of Regulation ³</u>			
	<u>23.6</u>	<u>15.5</u>	<u>33.0</u>

1. Excludes oil equalization tax in MPR Case and Windfall profit tax in CPD Case; note, oil equalization tax equals windfall profit tax.

2. Economic value calculated at marginal prices of oil, new gas, and coal.

3. Total economic value of domestic raw fossil energy at wellhead and minemouth level less sales costs of domestic raw fossil energy at wellhead and minemouth level; note, regulation cost equals windfall profit tax in CPD Case.

TABLE 10

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
ECONOMIC COSTS OF REGULATION PER MILLION BTU OF
RAW FOSSIL ENERGY AT THE WELLHEAD AND MINEMOUTH
LEVEL, 1985

<u>Policy Case</u>	<u>Raw Fossil Energy Cost per Million Btu¹ (1975 dollars)</u>
MPR	38.2 cents
CPD	23.8 cents
BAU	52.8 cents

-
1. Economic cost of regulation in Table 9 divided by Btu of domestic fossil energy production in Table 4.

TABLE 11

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
NEW TAXES FOR MODIFIED PRICE REGULATION CASE, 1985

<u>Source of New Taxes</u>	<u>Tax Computations</u>		
	<u>Tax Rate</u> (1975\$)	<u>Use</u> (billion)	<u>Tax</u> (billion 1975 \$)
<u>Taxes Exogenous to Industry Model</u>			
Gasoline	14.70/bbl	2.381 bbls	35.00
Industrial Distillate	2.760/bbl	0.196 bbls	0.54
Industrial Residual	2.944/bbl	0.181 bbls	0.53
Industrial LPC	2.024/bbl	0.076 bbls	0.15
Industrial Kerosene	2.714/bbl	0.018 bbls	0.05
Industrial Natural Gas	1.586/smcf	7.482 smcf	11.87
Total Exogenous Taxes			\$48.14
<u>Taxes Endogenous to Industry Model</u>			
Natural Gas in Electricity Generation			
East Coast Region		0.953 quads	1.18
Rest of Country		3.049 quads	3.78
Oil Products in Electricity Generation			
East Coast Region		2.150 quads	0.43
Rest of Country		1.467 quads	0.29
Natural Gas in Process Industries		neg.	neg.
Oil Products in Process Industries		1.921 quads	0.88
Oil Equalization Tax (Windfall Profits Tax)			
Lower Tier Oil (pre '74)		1.43 bbls.	12.78
Upper Tier Oil ('74-'77)		0.38 bbls.	1.28
Lower Tier NCL (pre '74)		0.22 bbls.	1.38
Upper Tier NCL ('74-'77)		0.04 bbls.	0.09
Total Endogenous Taxes			\$21.97
Total New Taxes of NPR Case			\$70.11

TABLE 12.

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
 ECONOMIC COSTS OF SATISFYING FINAL ENDPRODUCT
 REQUIREMENTS IN THE FOSSIL ENERGY SECTOR AT
 THE WHOLESALE LEVEL, 1985

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
Oil Imports (Bil '75 \$)	29	32.5	39
Domestic Industry (Bil '75 \$)	132	144.0	121
New Taxes (Bil '75 \$)	70	15.5	0
Total	231	192	160
Fossil Energy Use (quadrillion Btu)	74.7	79.4	79.5
Economic Cost per Million Btu at Wholesale Level (1975 dollars)	\$3.09	\$2.42	\$2.01

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APPENDIX I-

CARTER'S NATIONAL ENERGY PROGRAM ELEMENTS: A SUMMARY

The following is a summary of a 26-page fact sheet distributed to the press a few hours before the President unveiled his energy plan to Congress on the night of April 20. The fact sheet itself is a summary of legislation which may total 1,500 pages and administrative actions required by the program. Statements in parentheses have been added by the GEAC staff for clarification or emphasis.

CONSERVATIONEvaluated InModeling Transportation

- no --Gas guzzler tax and rebate. Graduated tax and rebates on new cars and light trucks linked to fuel efficiency; begins in 1978 and increases through 1985; the break point between tax and rebate increases from 18 mpg in 1978 to 27.5 mpg in 1985; highest tax in 1978 (for 12.5 mpg or less) is \$449 increasing to \$2,488 in 1985; highest rebate over the period is \$499 (for 39 mpg or better); rebates for foreign cars are subject to negotiation.
- no --May withhold federal highway funds from states not enforcing 55 mph speed limit (Texas Legislature is considering bills easing penalties for 55 mph violators).
- yes --Standby gasoline taxes to go into effect if consumption targets are not met; tax amounts to 5 cents per gallon per year not to exceed 50 cents per gallon; earliest possible tax is January, 1979; tax may be reduced when targets are met; all taxes collected will be rebated through income tax system.
- no --Removal of 10% excise tax on intercity buses; increase aviation gas tax by 4 cents and motorboat gas tax by 2 cents.
- no --New federal government vehicles to exceed fuel efficiency standards by 2 mpg in 1978 and 4 mpg in 1980.

Buildings

- no --Tax credit to homeowners of 25% of first \$200 and 15% of next \$1,400 spent on approved conservation measures undertaken before 1985.
- no --State utility commissions "required" to direct utilities to offer customers a residential energy conservation service to be repaid through monthly utility bills.
- no --Government-backed home improvement conservation loans.
- no --Low-income weatherization funding increased to \$130 million in FY 78 and \$200 million in FY 79 and FY 80.
- no --Rural home weatherization through electric cooperatives.
- no --Businesses given additional 10% tax credit for conservation investments.
- no --Federal grants to non-profit schools and hospitals, \$300 million per year for three years.
- no --HUD will advance by one year (from 1981 to 1980) the effective date for mandatory standards required for new residential and commercial buildings under the Energy Conservation and Production Act. Funds to states to help in this effort.

Appliances

- no --Present voluntary standards to be made mandatory for certain appliances. Ongoing labeling program to continue.

Industry

- no --Five year 10% investment tax credit for energy-saving capital improvements.
- Co-gen- --to encourage cogeneration (the production of industrial steam and electricity from the same facility) industrial cogenerators will be exempt from utility regulations; government guarantee of fair rates for back-up power; 10% tax

credit to purchase cogeneration equipment; possible exemption from conversion orders.

Rate Reform

- no --State utility commissions must eliminate promotional rates which do not reflect cost-of-service.
- no --Utilities must offer customers daily off-peak rates (customer pays for metering) and interruptible rates.
- no --Prohibition of master metering for new buildings.
- no --Gas utilities would have to discontinue declining block rates.
- no --Required interconnection and power pooling among intrastate electric utilities (aimed at the Texas Interconnected System and its current problems).
- yes --Taxes on oil and gas to encourage conservation (details below).

OIL & GAS PRICING

Oil Pricing

- yes --Continue indefinitely the \$5.25 lower tier and \$11.28 upper tier prices to be adjusted for inflation.
- yes --Allow newly discovered oil to rise over three year period to current world price (about \$14) with inflation adjustments.
- no --Define new oil as oil from wells drilled more than 2 1/2 miles from an existing well or 1,000 feet deeper than other wells in a 2 1/2 mile radius. All new OCS leases will be defined as new oil.
- yes --Stripper oil and incremental tertiary recovery oil will be unregulated.
- yes --Alaskan crude will be considered upper tier oil (\$11.28 adjusted) and treated as foreign oil for purposes of entitlements. New Alaskan finds will be "new" oil. Elk Hills NPR production will be limited until west-to-east transportation system is in place.
- no --Shale oil to receive world market prices.
- yes --All domestic production will be subject to an equalization tax to be imposed in stages such that by 1980 all domestic crude will be taxed at a per-barrel rate sufficient to equal the world market prices. Taxes to be rebated through income tax (would end entitlements program).

Gas Pricing

- yes --All new gas sold in U.S. (including intrastate gas) cannot exceed the Btu equivalent of the average refiner acquisition cost of domestic crude before tax (or about \$1.75 per mcf).
- no --Define "new gas" using same standards as "new oil" (2 1/2 miles, 1,000 feet and new OCS leases).
- no --Certain high cost gas may have higher price ceilings.
- no --Gas from expiring interstate contracts may sell for up to \$1.42 per mcf. Expiring intrastate gas may sell at \$1.75 ceiling.
- no --Allocates the cost of more expensive new gas to industrial users (incremental pricing).
- no --Extends federal controls to SNG plants.

CONVERSION (away from oil and gas)

Oil and Gas Users Tax

- yes --Beginning in 1979 industrial gas users (excepting agricultural) will be taxed such that their gas costs equal a "target" based on fuel oil prices. The target price will rise to equal fuel oil prices by 1985. The target for 1979 will be \$1.05 below the Btu equivalent cost of fuel oil.
- yes --Electric utilities will bear a similar tax beginning in 1983 (with fuel oil

- price parity achieved in 1985).
- yes --Petroleum used by industry will be taxed at 50 cents per bbl in 1979 rising to \$3 per bbl in 1985. A similar tax on utility use of petroleum will begin in 1983 at a rate of \$1.50 per bbl (and remain constant).
 - no --Industry to receive either a 10% investment tax credit for conversion expenditures or a rebate of oil and gas taxes paid equal to conversion costs.

Mandatory Conversion Regulations

- yes --Ban on new oil and gas-fired boilers.
- yes --Prohibits any utility from burning gas after 1990.

Environmental Policy for Coal

- yes --Requires best available technology (scrubbers) in all new coal-fired plants.
- uncertain --Continues "significant deterioration" policy.
- no --Tough federal strip mining law.

Coal Research and Development

- no --Extensive R&D into clean coal burning technologies, pollution control and coal gasification and liquefaction.

Nuclear Power

- no --Reiteration of previously announced policies on nuclear proliferation, plutonium recycle and deemphasis of breeder technology.
- no --Expansion of enrichment capacity.
- no --Stepped-up safety monitoring of existing light water reactors.
- no --Streamline licensing process for standardized plant designs.

Solar Power

- no --Tax credits of 40% of the first \$1,000 and 25% of the next \$6,400 for approved solar installations; credits gradually diminish through 1984 then expire.
- no --\$100 million three year program for solar additions to federal buildings.
- no --Increased funding for solar, wind, biomass and other alternate source research, development and demonstration.
- no --Business tax credits for solar investments for industrial and commercial use (eligible for 10% conservation tax credits).
- no --State utility commissions required to develop guidelines to prevent discriminatory rates against solar users.

Geothermal Energy

- no --Tax deductions for geothermal drilling operations.
- no --Streamline leasing and environmental review procedures to develop geothermal resources on federal lands.
- no --Extensive funding of development of gas resources from geopressured zones (Texas and Louisiana, primarily).

OTHER ELEMENTS

Energy Reserve, Production and Financial Reporting

- no --Government assumption of audit and verification roles now performed by AGA and API in determining reserve and production statistics.
- no --Elimination of redundant reporting requirements by federal agencies.
- no --Extensive financial reporting by major oil and gas companies based on functional areas of production, refining, transportation and marketing and geographic regions (viewed by some as a substitute for divestiture and by others as a first step to divestiture).
- no --Rejection (for the moment) of either horizontal or vertical divestiture with close monitoring of anti-competitive actions.
- no --State energy offices, assisted by the federal government, to collect data on

energy availability and reliability.

Low-Income Assistance

- no --In addition to weatherization program and tax rebates, there will be rebates to users of home heating oil (mostly in the East and North).

Strategic Petroleum Reserve

- no --Expand SPR program from 500 million bbl storage to 1 billion bbl, enough to withstand serious supply interruptions for 10 months.

Liquefied Natural Gas

- Limited LNG imports allowed --Removal of current import limitation on LNG coupled with strict siting criteria.

Outer Continental Shelf

- no --Support of current OCS bill before Congress (which industry says will hamper rather than expedite OCS production).

Gasoline Decontrol

- yes --Removal of gasoline price control and allocation regulations by next fall (would likely eliminate the question of "passthrough" of a potential Texas refinery tax).

Industry Taxation

- no --Give independents same tax relief as majors in the treatment of intangible drilling costs.

Studies, Inspections, Investigations, Etc.

- no --In addition to the administrative action and proposed legislation, the plan calls for a variety of inquiries into such areas as the adequacy of the energy transportation system, energy development and price impacts, industry competition, environmental considerations of coal conversion, uranium and thorium resource evaluation, and a search for additional hydroelectric sites.

If all the above is carried out, the President hopes the following goals will be reached.

GOALS (for U.S. by 1985)

Reduce annual growth of demand to less than 2% (historic growth is about 3 1/2%); reduce oil imports from forecasted 10 million b/d to 6 million; reduce gasoline consumption by 10% (presumably over current levels); insulate 90% of buildings; increase coal production by 400 million tons per year (from current level of about 650 million); and use solar energy in 2 1/2 million homes.

APPENDIX II

COAL SUPPLY, BENEFICIATION, AND TRANSPORTATION

Briefly, economic supplies of coal produced in the Eastern, Midwestern, and Western Regions of the nation were developed as follows: price-quantity data were extracted from FEA's Coal Report (1976) with key states being selected for each major producing region; each supply point was categorized according to Btu content and sulfur content; FEA's regions were aggregated into Eastern, Midwestern, and Western Regions; and FEA's many coal type classifications were aggregated to give four coal types: Eastern High Sulfur (EHC), Eastern Low Sulfur (ELC), Midwestern High Sulfur (MHC), and Western Low Sulfur (WLC); FEA data within the four coal types were summed to give four step-function supply curves for coal; and piecewise linear approximations of each step-function were used to derive a price-quantity pairing for each coal type.

Central and Eastern coal consuming regions are used in the model to prevent large quantities of western low sulfur coal from being shipped to the electric power industry on the East Coast at an unrealistically low price. The Central coal consuming region is assumed to consist of the states west of the Appalachian Mountains; and the Eastern coal consuming region is assumed to consist of the states east of the Appalachians. Areas served by barge transport on the Mississippi and Ohio Rivers are included in the Central Region.

All of the petroleum refining and chemicals industries are assumed to be in the Central Consumption Region to minimize computational time. No provisions are made for other special regions like the West Coast of the United States.

Coal Supply for the Model

Coal supply curves were developed for the model based on the data and methodology used during 1975-76 in the Project Independence Evaluation System (PIES) of the Federal Energy Administration (FEA). The PIES coal supply methodology is based on Bureau of Mines reserve base estimates of coal tonnage and quality characteristics by seam and county (FEA, 1976). The PIES methodology assigns Bureau of Mines coal reserves to 32 product quality categories (8 sulfur content ranges x 4 Btu content ranges), and to a large number of mine type categories. Mine type categories are differentiated by surface or deep mine technology, size of mine, and depth and thickness of coal seam. For surface mines the depth below ground and thickness of a coal seam are combined to give the parameter "overburden ratio," the ratio of cubic yards of overburden material removed per ton of coal mined. In the PIES analysis a mining cost model was used to develop capital and operating costs for each mine type. The PIES methodology thus defines a set of hypothetical coal mines that exploit the entire U.S. coal reserves as defined by the Bureau of Mines.

In the PIES methodology a fraction of the entire set of hypothetical coal mines is identified as corresponding to existing U.S. capacity. Coal is assumed to be produced by these mines provided the market price covers variable costs of production. The remaining mines are mines built after 1976 and are only brought into production when the market price covers all costs plus 8% per year return on investment.

In the PIES model supply curves are generated by aggregation of

the hypothetical coal mines over 12 geographical regions and three product types: metallurgical coal, low sulfur coal, and high sulfur coal.

Metallurgical coal is defined as coal in the highest PIES Btu content range (greater than 26 million Btu per ton) and the two lowest sulfur content categories (less than 0.6 lb sulfur per million Btu). PIES low sulfur coal is defined as coal which does not meet metallurgical specifications but has a sulfur content of less than 0.72 lb sulfur per million Btu. PIES low sulfur coal is defined such that it meets EPA new source SO_x performance standards (1.2 lb SO_2 /MMBtu coal) either as is or after beneficiation. PIES high sulfur coal is defined as all coal which contains more than 0.72 lb sulfur per million Btu.

For the work reported here, the 12 PIES geographical regions were aggregated into three regions: the three PIES Appalachian regions were combined into one Eastern region; the PIES Midwest and Central-West regions were combined and designated Midwestern; and the PIES Western Northern Great Plains region (western Montana, Wyoming, and northern Colorado) was taken to represent the Western region for the model.

Further, coal was allocated into four representative types: eastern low sulfur coal type (code ELC), eastern high sulfur (EHC), midwestern high sulfur (MHC), and western low sulfur (WLC) coals. Coals MHC and WLC were defined as all coal in the midwestern and western regions, respectively, with the exception of metallurgical grades. The eastern region has coal with a very wide range of sulfur contents, and coal types ELC and EHC are defined such that roughly half of the eastern non-metallurgical coal reserves are in each representative type. Type

Table 1

POINTS DEFINING STRAIGHT-LINE-SEGMENT COAL SUPPLY CURVES

<u>Coal Type</u>	<u>Price - \$/ton</u>	<u>Quantity - 10⁶ tons/yr.</u>
ELC	10.00	0
	16.20	230
	21.60	660
	33.10	1100
	107.00	1155
LHC	7.70	0
	16.60	150
	20.40	460
	33.10	810
	107.00	857
MHC	6.50	0
	8.90	125
	15.00	160
	19.60	960
	31.00	1450
	94.70	1483
WLC	5.50	0
	9.20	450
	19.30	2700
	28.50	3850

ELC is defined as coal with a sulfur content of less than 1.68 lb/million Btu but not meeting metallurgical quality standards. Type EHC is defined as coal exceeding 1.68 lb/million Btu in sulfur content.

A supply curve was generated from the PIES mine cost data for each of the four representative coal types. This was done by assigning each PIES hypothetical coal mine to the appropriate representative coal type. The mine data for each type were then arranged in order of increasing coal selling price, and selling price was plotted versus cumulative mine capacity to give a supply curve consisting of a large number of small discrete stair-steps, with each step representing the addition of one or more mines to the production base. It was found that these supply curves could be well represented by sets of 3 to 6 straight-line segments fitted to the stair-steps. Table 1 presents the supply curves for the four representative coal types. If the price-quantity data in Table 1 are plotted and the points connected by straight lines, the supply curves are obtained.

Representative ash, sulfur, and Btu contents were assigned to each of the four coal types. Ash content of the coal was not specified in the PIES data. Ash content of coal varies widely, but it does not show any pronounced trends from region to region (Deurbrouck, 1972). Accordingly, all types of coal were assumed to have the same ash content, 17% by weight. As the cumulative production quantities were computed for the supply curves, cumulative average sulfur and Btu contents were also computed. As individual mines with differing coal qualities are added to the production base, the cumulative average sulfur and Btu contents vary slightly. The

Table 2

RAW COAL PROPERTIES

<u>Coal Type</u>	<u>% Sulfur</u>	<u>% Ash</u>	<u>Btu/lb.</u>
ELC	1.4	17.	13000
EHC	3.0	17.	12000
MHC	3.0	17.	10800
WLC	0.4	17.	8400

Table 3

BENEFICIATED COAL PROPERTIES

<u>Coal Type</u>	<u>% Sulfur</u>	<u>% Ash</u>	<u>Btu/lb.</u>
ELE	1.19	6.8	14690
ENB	2.11	6.8	13560
MHB	2.11	6.8	12200
WLB	0.38	6.8	9490

Table 4

COAL TRANSPORTATION COSTS PER TON

<u>Coal Type</u>	<u>To Central Region</u>	<u>To Eastern Region</u>
Eastern (ELC, EHC, ELB, ENB)	\$8	\$5
Midwestern (MHC, MHB)	\$4	\$8
Western (WLC, WLB)	\$10	\$20

sulfur and Btu contents given in Table 2 were selected as being typical values for the four coal types.

Coal Beneficiation

Beneficiation, or "washing," is carried out at the mine mouth to improve coal quality by separating heavy sulfur-bearing and ash-producing inorganic minerals from the lighter, burnable, organic portion of the coal. Raw coal is crushed and slurried in water, and the separation is carried out on jigs, tables, "spirals," air flotation units, or other apparatus. The final product is dried in a rotary drier and the discarded material is reburied in the mine. (U. S. Dept. of Commerce, 1975; Cavallaro et al., 1974; Deurbrouck, 1972.)

Different levels of treatment are possible with coal beneficiation. The coal may be crushed to a fine mesh size and passed through a multi-stage separation device to achieve a high level of cleaning, or it may be coarse-crushed and separated in a simple apparatus to obtain a low level of cleaning. The process assumed for the model is described in the literature as "Level 3," a medium level process (U. S. Dept. of Commerce, 1975). We assume that this process reduces the ash content to 40% of its original value (i.e., from 17% to 6.8%). Also, the Btu content per lb is increased by 13%. We assume that 1.25 tons of raw coal are required to produce one ton of beneficiated coal. Some fuel value is lost in the discarded material, and approximately 40 lb of coal and 0.4 gallons of fuel oil are burned as drier fuel per ton of product (Lyons, 1950). Capital cost for beneficiation is assumed to be \$4.22 per ton

per year capacity, and operating cost excluding energy costs is assumed to be \$0.52 per ton. A 20% per year capital charge is applied. (U. S. Dept. of Commerce, 1975.)

Coal contains the inorganic sulfur mineral pyrite (FeS), which can be mechanically separated and removed by beneficiation. It also contains organic sulfur compounds which cannot be removed by beneficiation. As a general rule, high sulfur coals contain pyrite and organic sulfurs in roughly equal proportions. In low sulfur coals nearly all sulfur is organically combined. For the model, sulfur removal percent was assumed to be a function of raw coal sulfur content:

$$(\text{Percent S removal}) = 11 (\%S)^{0.9}$$

Thus for 3% sulfur coal 30% removal is expected, but for 0.4% coal only 5% removal is expected by beneficiation. Tables 2 and 3 give the properties of the four representative coal types before and after beneficiation, respectively.

The economic justification for beneficiation of steam boiler coals may stem from different factors. For all coals in the model, ash disposal costs at the boiler are reduced by 60%. For high sulfur coals, sulfur removal is an important benefit. For low sulfur western coals which must be transported long distances, the reduction in weight per Btu is significant in the model.

Coal Transportation Costs

In the model coal is assumed to be mined and beneficiated in the three regions, Eastern, Midwestern, and Western, as described above.

Two coal consuming regions, Central and Eastern, are used in the model to prevent large quantities of western low sulfur coal from being shipped to the eastern electric power industry at an unrealistically low price. To avoid further addition of rows and increased computation times, the petroleum refining, chemical, and plastics industries are assumed to be located in the Central consuming region. Also, no provision is made for other special regions, such as the U. S. West coast.

The Central coal consuming region is assumed to consist of the portion of the country west of the Appalachian Mountains, including areas served by barge transport on the Mississippi and Ohio Rivers. The Eastern region consists of the easternmost tier of states.

Table 4 gives the coal transportation costs assumed for the model. These costs were estimated based on PIES cost data (Childress, 1976).

APPENDIX III

REVISIONS TO OTHER COMPONENTS OF MODELLING SYSTEM

In the interim between the analyses reported in The Costs of Energy (Thompson et al., eds., 1977) and the analyses for GEAC reported here, a number of revisions and improvements have been made to the various components of the overall system. A wholly new supply model was developed for oil and gas and has been documented separately (Kim and Thompson, 1977). A price-sensitive coal supply model was adapted from the work of FEA as described in Appendix III. Additional changes to and substitutions in the linear programming industry model, the end product demand model, and the supply-demand-industry interface will be briefly outlined here.

Revisions to Industry Model

- (1) Process vectors designed to represent the production of nylon (and its precursors) and low density polyethylene were added to the model. New vectors for polyvinyl chloride were developed from more recent data.
- (2) Extensive revisions were made to the electric power industry component of the model, both in terms of structure and estimates of process parameters. Major revisions were made in the method of accounting for air emissions and the control thereof. New cost and energy requirement parameters were developed for air emissions control processes and many of the production processes. However, the electricity generating unit types and utilization factors were retained from the previous version of the model.

As mentioned previously, the electric power component was also separated into two regions so as to account properly for the generation cost impact of the differences in coal transportation costs.

(3) Coincident to the revisions to the electric power sector a new system of vectors was designed to more accurately represent the burning of coal and fuel oil, both in large power plant boilers and in the kind of smaller boilers likely to be used by the process industries. FORTRAN programs were developed to estimate air and water emissions, and pollution control costs (precipitators and wet scrubbers) for the various types of boiler fuel. In the model, it is possible to burn eight types of coal, three grades of residual fuel oil, and two grades of distillate fuel oil.

Fuel burning in each industry was required to comply with a specified standard of allowable air emissions. Particulate control was required for any fuel with a non-trivial ash content. Additionally, each industry was required to mix fuels or employ stack scrubbers as necessary to achieve an average sulfur oxide emission standard. New source performance standards were specified as 1.2 lbs SO_2 /MMBtu for coal and 0.8 lbs SO_2 /MMBtu for oil. Because of the variance in old source emission standards, a standard 1.5 times that of the new source standard for coal was imposed. For old oil plants the emission standard was set at 1.05 lb SO_2 per million Btu, which is equivalent to burning 1% sulfur oil without scrubbers. The distinction between old and new sources for electric power was clear-cut since the industry model explicitly deals with old and new plants in that industry. Such detail is generally not modelled for the process industries, however, and a further approximation was required.

III-2

All coal-fired boilers were assumed to be new sources since the industries modelled do not currently use a great amount of coal as boiler fuel.

All existing plant (pre 1975) boilers were assumed to be oil-fired.

The capacity of pre-1975 boilers in 1985 plants was assumed to be approximately one-half of that required in a typical 1985 solution of the model (e.g. the CPR case described above). However, the model chooses in all cases to discard its existing oil-fired industrial steam boilers and retrofit coal-fired ones, even when stack-gas scrubbers are required.

As in previous versions of the model process heaters are assumed not able, for technical reasons, to burn coal or residual fuel oil.

Finally, the end product demands for coal and fuel oils supplied by the industry model (as opposed to consumed by it) were required on the average to meet the new source standard without sulfur control (fuel oils) or meet a standard 1.25 times the new source standard (coal). This is appropriate for residential and commercial demands since those establishments are generally of insufficient scale to install stack gas scrubbers. It is not completely appropriate for exogenous industrial demand, but the technique does indirectly account for the costs of sulfur control in non-modelled industries as the premium on the price of clean fuel supplied to those industries is determined by the cost of emission control on dirtier fuels as explicitly and accountably included in the industry model. By a similar logic, the costs of particulate control on these "sold" fuels is included in the objective function in order to prevent the occurrence of a cheap "out" for fuels with a high ash content.

(4) New estimates were made of the existing capacities of the different kinds of fossil-fueled electric power plants. Data published by the National Electric Reliability Council (1975) were employed, as that provided by the Federal Power Commission does not disaggregate steam generation among the various fossil fuel types. Unfortunately, the NERC regional disaggregation did not completely correspond to the regionalization used in the model (which is based on FEA regions which are based on FPC regions). Accordingly, adjustments based on our experience were made for two NERC regions which overlap FPC regions.

(5) Production levels specified for the numerous products included in the industry model were all re-estimated on the basis of the most current data available. Such a re-estimate was believed important in order to account for the rather abrupt decline in refinery and chemical production following late 1973. The primary source for these estimates was the Chemical Economics Handbook which had largely complete data for 1974 and partial or projected data for 1975. The estimated 1975 production levels were then extrapolated to 1985 on the basis of assumed trends in population and income growth.

(6) Cost coefficients in the industry model were inflated to a 1975 price level on the basis of industry-specific components of the Chemical Engineering Plant Cost Index and the Marshall and Stevens Equipment Cost Index.

(7) To reduce the size of the model, and hence the solution time, the explicitly modelled wastewater treatment systems in each industry were removed from the model. These were replaced by cost rows to sum wastewater treatment costs for each industry. Process activities in the model previously contributed gallons of wastewater and lbs of BOD, COD, etc., to a wastewater treatment system. In the current model a process activity has a single coefficient in a wastewater cost row.

The value of the cost coefficient in each process vector was estimated using the U. R. Industry Studies Wastewater Treatment Simulation Model (UHTMOD). First, representative treatment plant raw waste loads were chosen as shown in Table 1. Parameters in UHTMOD were adjusted to give reasonable wastewater treatment plant designs for each raw waste load. Each design contained primary, secondary, and tertiary treatment capacity sufficient to meet EPA 1983 (BAT) effluent standards. For the petroleum refining and organic chemical industries three additional UHTMOD simulations were run with 20% increases in water flow, COD raw waste load, and oil raw waste load. Three simultaneous linear equations were set up containing the water, oil, and COD raw wasteloads as coefficients and the treatment costs as right hand sides. Solution of the three equations gives

$$\text{\$Treatment Cost} = 1.126 (\text{flow, Kgal}) + 0.104 (\text{COD, lb}) - 0.132 (\text{oil, lb})$$

The treatment cost coefficients for each activity in the organic chemicals and petroleum refining industries were then computed from the above equation.

For the plastics and synthetic rubber industries the same procedure was followed except that total suspended solids were included to give four simultaneous linear equations. Raw waste loads were re-estimated based

Table 1 Representative Treatment Plant Raw Waste Loads for UHTMOD

Organic Chemicals and Petroleum Refining:

Flow:	1.08 Mgal/day
COD:	2523 mg/l
TSS:	100 mg/l
Oil:	567 mg/l

Plastics and Synthetic Rubber Industries - high COD:

Flow:	0.8 M gal/day
COD:	3000 mg/l
TSS:	200 mg/l
Oil:	50 mg/l

- low COD:

Flow:	0.8 M gal/day
COD:	800 mg/l
TSS:	167 mg/l
Oil:	42 mg/l

on EPA data (EPA, 1973) because in the earlier model suspended solids were neglected. Wastewaters from many processes involving polymers contain fine suspended polymer solids which exert COD. Also, two different treatment cost equations were estimated because COD concentration varies widely in these industries:

$$\begin{aligned} \$\text{Treatment Cost} = & 1.190 (\text{flow, Kgal}) + 0.090 (\text{COD, lb}) \\ & + 0.303 (\text{TSS, lb}) + 0.600 (\text{oil, lb}) \\ & \text{for COD} > 1550 \text{ mg/l} \end{aligned}$$

$$\begin{aligned} \$\text{Treatment Cost} = & 1.030 (\text{flow, Kgal}) + 0.145 (\text{COD, lb}) \\ & + 0.287 (\text{TSS, lb}) + 0.444 (\text{oil, lb}) \\ & \text{for COD} < 1550 \text{ mg/l.} \end{aligned}$$

New End Product Demand Model

Price-sensitive demands for coal, electricity, distillate and residual fuel oils, natural gas, LPG, gasoline, kerosene, and jet-grade naphtha were determined for the model by an adaptation of the energy demand model employed by FEA in the PIES methodology (FEA, 1976). The model is a constant elasticity approximation of the larger, dynamic FEA energy model. According to FEA, any such approximation corresponds to (is calculated at) a particular solution to the PIES model; the only elasticity matrix for which complete documentation was available was that for the \$13 Reference Scenario in the 1976 Energy Outlook. It is recognized that the elasticities and base demands drawn from this scenario involve judgmental considerations, but these judgments were unavoidable in light of the available

FEA documentation. The base demands corresponding to the elasticity matrix are disaggregated regionally by FEA. The product demands for these regions were grouped to provide base demands for the two gross regions used in the analysis reported here. That portion of demand expected to be accounted for by industries in the LP model was subtracted to avoid double counting. The elasticities are appropriately weighted averages of regional elasticities. The same elasticity matrix is used for the two regions. Region-specific base prices are documented, and region-specific demands were used to derive average weighted base prices for each of the two regions. Given these base prices and demands and the matrix of own- and cross-price elasticities, "new" demands could be calculated corresponding to prices implicit in the scenarios modelled here. For coal and electricity, demands for the east and central regions were specified separately to the model. For all other products, demands for the two regions were added together to yield a single national demand.

III-7

Interfacing the Industry Model Linear Program with the Demand and Supply Models

At market equilibrium, the prices input to the demand model should be the final product shadow prices from the industry model. Also, the prices input to the supply models should be the shadow prices of the raw materials supplied to the industry model (Lievano et al, 1977).

We denote the set of prices input to the supply and demand models by the vector $\underline{z}$ and the set of supply and demand product quantities computed by the supply and demand models as

$$\underline{q} = \underline{q}(\underline{z})$$

Given a set of supply and demand quantities entered into the Industry Model, the model computes a set of shadow prices

$$\underline{r} = \underline{r}(\underline{q}(\underline{z})) = \underline{r}(\underline{z})$$

for the supply and demand products.

To achieve market equilibrium the modeller needs to find the root $\underline{z}^*$ of the nonlinear vector equation

$$\underline{f}(\underline{z}) = \underline{r}(\underline{z}) - \underline{z} = 0$$

This is always done in practice by some iterative technique. The modeller assumes some starting estimate of $\underline{z}^*$, designated $\underline{z}_1$. He then computes $\underline{r}(\underline{z}_1)$ and estimates some new $\underline{z}$, $\underline{z}_2$, such that $\underline{z}_2$ is better estimate of $\underline{z}^*$ than $\underline{z}_1$. He then computes $\underline{r}(\underline{z}_2)$, etc., and iterates until the problem converges, i.e. the input prices equal the shadow prices $\underline{z} = \underline{r} = \underline{z}^*$

In early analyses with the model there were seven varying demands in the demand model which were calculated directly from the shadow prices of crude oil and natural gas by a formula external to the industry model. Also, the supply models used for oil, gas, and coal were virtually insensitive

to price so that they did not enter into the equilibrium (Thompson, et al, 1977).

Thus, in the early analyses the equilibration of the vector

$\underline{r}$ of shadow prices with the vector $\underline{z}$ of input prices was not actually done.

In later analyses done for Texas GEAC, the current demand model and similar - to-current coal and petroleum supply functions were used. The vector $\underline{z}$ of input prices to the demand model, 4 input prices to a coal supply model external to the industry model, and, for deregulated gas price, the natural gas price input to the external petroleum supply model. The vector $\underline{r}$ consisted of the shadow prices of the corresponding products and raw materials. The domestic crude oil and natural gas liquid shadow prices are always fixed within a narrow range of variation of less than 13% because imported oil price sets the petroleum price levels. Therefore fixed domestic crude oil and natural gas liquid input prices were used in the petroleum supply model.

With both demand prices and supply prices included in the equilibration prices, there is a large amount of interaction between prices. If the $\underline{z}$ -vector component for supply of one type of coal is increased, the $\underline{r}$ -vector components for electricity demand, coal demand, and coal supply will be affected, and the components for gas supply and demand are usually also affected. The vector of shadow prices, $\underline{r}$, is usually extremely sensitive to small changes in the supply price components of $\underline{z}$. In an effort to obtain faster convergence, Broyden's root finding method was used:

$$\underline{z}_i + 1 = \underline{z}_i + t_i \underline{p}_i$$

$$\text{where } \underline{p}_i = \underline{H}_i (\underline{r}_i - \underline{z}_i),$$

t_i is an acceleration parameter between 0 and 1 adjusted by the user at each iteration, and $\underline{H}$ is a matrix which depends on the convergence history of the problem

(Broyden, 1965). H is initially an identity matrix, and is then updated

at each iteration by

$$\underline{H}_i = \underline{H}_{i-1} - \frac{[\underline{r}_{i-1} \quad \underline{p}_{i-1} + \underline{H}_{i-1} (\underline{f}_i - \underline{f}_{i-1})] \underline{p}_{i-1}^T \underline{H}_{i-1}}{\underline{p}_{i-1}^T \underline{H}_{i-1} (\underline{f}_i - \underline{f}_{i-1})}$$

where $\underline{f}_i = \underline{r}_i - \underline{z}_i$

In an effort to reduce the high sensitivity and large number of interactions in the convergence procedure, the current version of the model was developed. In this version the petroleum and coal supply models are internal to the industry model as a set of stair-step functions. Development of the stair-step functions for coal is described in Appendix II above. Ability to express the petroleum supply model internal to the industry model depends on the assumption, also used in the previous versions of the model, that the crude oil and natural gas liquid supply prices are fixed, even in a free market situation. Kim's petroleum supply model was used to generate curves of natural gas, crude oil, and natural gas liquids as a function of gas price. These curves were interpolated at \$0.01/KSCF intervals to give a stair-step supply function with \$0.01/KSCF price steps.

A column vector in the industry model was defined for each stair step. As in the coal supply vectors each gas supply vector has a unit entry for gas production and an entry in the cost row equal to the gas price. However, each gas supply vector also has the two additional entries specifying the amount of crude oil and natural gas liquids produced per unit of gas produced in the given stair step. The bounds section of the model specifies the amount of gas produced in each stair step. The crude oil and natural gas liquid supplies from each stair step are summed and passed

through transfer column vectors which apply their costs (via fixed input prices) to the objective function.

With the supply functions internalized in the industry model the $\underline{z}$ and $\underline{r}$ price vectors contain the 11 demand model prices only. Convergence problems due to the extreme sensitivity of the shadow prices to coal supply model input prices have been eliminated.

One problem which frequently exists in the interfacing the industry model with supply or demand models to obtain market equilibrium is the so-called "corner point" problem. This problem is illustrated in Figure III-1, which represents the interfacing a linear programming (LP) model of production of one product with an econometric model for the demand of the product. The corner point problem comes about because the supply curve generated by the LP is a stair step. The product shadow price r only takes on a limited number of discrete values over a given range of production. If the demand model gives demand curve A, an equilibration procedure results in an equilibrium market price z_A equal to the shadow price r_1 with equilibrium production of product at q_A . However, if the demand model gives curve B all attempts to obtain exact equilibration fail because z as a function of q passes through the vertical portion of the stair step. As the modeller increases the trial z , hoping to obtain $z=r$, the value of r suddenly drops from $r_2 > z$ to $r_1 < z$.

Error due to the corner point problem is diminished if the shadow price r changes by only small percentages in each step. An LP model which is flexible i.e. represents a large number of closely spaced alternatives, frequently gives this behavior. The Modified Price Regulation (MPR) case described above has fixed petroleum supplies, and has a corner point problem in the gas demand price, whereas no problems were observed during convergence

III-11

Figure III-1

Intersection of Supply and Demand Curves Giving the "Corner Point" Problem

of Complete Price Deregulation case, which has flexible petroleum supplies from a large number of closely spaced supply vectors. Fortunately, the MPR gas demand curve intersected the stair step supply curve very close to upper end of a vertical section, and the unavoidable convergence error was only 1%.

Broyden's algorithm, described above, was derived for continuous functions, and implicitly involves partial derivatives of the function $\underline{r}(\underline{z})$. If, due to the corner point problem, the function $\underline{r}(\underline{z})$ is highly discontinuous, the method breaks down. With the highly sensitive 16-component convergence problem, Broyden's algorithm seemed to perform properly during the first four or five iterations. However, as convergence was more closely approached, corner point problems would tend to destroy the usefulness of the $\underline{H}$ matrix. Therefore the $\underline{H}$ matrix was usually "frozen" after the first four or five iterations, i.e. the matrix updating formula was not used thereafter. With the current version 11-component convergence problem, initial approach to convergence is obtained in only one or two iterations, and Broyden's algorithm is frequently not useful at all. The $\underline{H}$ matrix is usually taken as a diagonal matrix with heuristically chosen component values.

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Chapter 5

Administration

The National Energy Plan

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THE WHITE HOUSE
WASHINGTON

APRIL 29, 1977.

In each period of our history, the nation has responded to challenges which have demanded the best in all of us.

This is one of those time.

Our energy crisis is an invisible crisis, which grows steadily worse—even when it is not in the news. It has taken decades to develop, as our demand for energy has grown much faster than our supply. It will take decades to solve. But we still have time to find answers in a planned, orderly way—if we define the changes we must make and if we begin now.

This report explains why we have to act, and gives you the details of our Plan. The Plan is complicated. I am sure that many people will find some feature of it they will dislike along with features they can support. But it is a carefully balanced Plan, which depends for its effectiveness on all of its major parts.

Above all it is fair. Our guiding principle, as we developed the Plan, was that none of our people should be asked to bear an unfair burden, and none should reap an unfair advantage. There will be sacrifices, but they will be gradual, reasonable—and fair.

The changes the Plan recommends will mean a new direction in American life. In some cases heading in that direction may seem inconvenient. But I have faith that meeting this challenge will make our lives more satisfying.

We can rediscover the ingenuity and the efficiency which have made our nation prosper, rather than deepening our dependence on insecure imports and increasingly expensive conventional energy supplies. We can rediscover small-scale, more creative ways of satisfying our needs. If we are successful, we can protect jobs, the environment, and the basic American standard of living, not only for ourselves but also for our children and grandchildren.

I know that, if we work together as a united people, we will succeed.

A handwritten signature in cursive script, reading "Jimmy Carter". The signature is written in dark ink and is positioned in the lower right quadrant of the page.

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Overview

The diagnosis of the U.S. energy crisis is quite simple: demand for energy is increasing, while supplies of oil and natural gas are diminishing. Unless the U.S. makes a timely adjustment before world oil becomes very scarce and very expensive in the 1980's, the nation's economic security and the American way of life will be gravely endangered. The steps the U.S. must take now are small compared to the drastic measures that will be needed if the U.S. does nothing until it is too late.

How did this crisis come about?

Partly it came about through lack of foresight. Americans have become accustomed to abundant, cheap energy. During the decades of the 1950's and 1960's, the real price of energy in the U.S. fell 28 percent. And from 1950 until the quadrupling of world oil prices in 1973-1974, U.S. consumption of energy increased at an average annual rate of 3.5 percent. As a result of the availability of cheap energy, the U.S. developed a stock of capital goods—such as homes, cars, and factory equipment—that uses energy inefficiently.

The Nature of the Problem

The most critical increase in demand has been for oil, the most versatile and widely used energy resource. To meet that growing demand, the U.S. has turned increasingly to imports. In January and February of 1977, the U.S. imported about 9 million barrels of oil per day, half of total domestic oil consumption. By 1985, U.S. oil consumption could equal 12 to 16 million barrels per day.

U.S. domestic oil production has been declining since 1970. New production from Alaska, the deep Outer Continental Shelf, and new recovery methods should reverse the decline, but will be unable to satisfy the projected growth in U.S. demand. Other major additions to domestic oil supply are unlikely.

The principal oil-exporting countries will not be able to satisfy all the increases in demand expected to occur in the U.S. and other countries throughout the 1980's. In 1976, the 13 OPEC countries exported 29 million barrels of oil per day. If world demand continues to grow at the rates of recent years, by 1985 it could reach or exceed 50 million barrels per day. However, many OPEC countries cannot significantly expand production; and, in some, production will actually decline. Thus, as a practical matter, overall OPEC production could approach the expected level of world demand only if Saudi Arabia greatly increased its oil production. Even if Saudi Arabia did so, the highest

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levels of OPEC production probably would be inadequate to meet increasing world demand beyond the late 1980's or early 1990's.

There are physical and economic limits on the world's supply of oil. A widely used geological estimate of total recoverable world oil resources, past and present, is about 2 trillion barrels. More than 360 billion barrels have already been consumed. Current proved crude reserves are 600 billion barrels. World consumption of oil has grown at an average annual rate of 6.6 percent since 1940, and it grew by as much as 8 percent annually during the 1960's.

If it could be assumed that world demand for oil would grow at an annual rate of only 3 percent, and if it were possible (which it is not) that production would keep pace with that rate of growth, the world's presently estimated recoverable oil resources would be exhausted before 2020. At a conjectural growth rate of 5 percent, those resources would be exhausted by 2010. Despite some uncertainty about the exact size of recoverable world oil resources, and about the rate of increase of productive capacity, this fundamental fact is clear: *within about four generations, the bulk of the world's supply of oil, created over hundreds of millions of years, will have been substantially consumed.*

Of course, actual physical exhaustion of oil resources will not occur. Even today, well over half the oil in existing fields is being left in the ground because additional recovery would be too expensive. As production by conventional methods declines and oil becomes more scarce, its price will rise and more expensive recovery methods and novel technologies will be used to produce additional oil. As this process continues, the price of oil will become prohibitive for most energy uses. Eventually the nations of the world will have to seek substitutes for oil as an energy source, and oil will have to be reserved for petrochemical and other uses in which it has maximum value.

The world now consumes about 20 billion barrels of oil per year. To maintain even that rate of consumption and keep reserves intact, *the world would have to discover another Kuwait or Iran roughly every three years, or another Texas or Alaska roughly every six months.* Although some large discoveries will be made, a continuous series of such finds is unlikely. Indeed, recent experience suggests that, compared to world oil consumption, future discoveries will be small or moderate in size, will occur in frontier areas, and will yield oil only at very high cost. Obviously, continued *high rates of growth* of oil consumption simply cannot be sustained.

Natural gas supplies are also limited. In the U.S., natural gas constitutes only 4 percent of conventional energy reserves, but supplies 27 percent of energy consumption. Gas consumption grew about 5.7 percent per year between 1960 and 1970. From 1970 to 1974, however, consumption dropped 1.3 percent. The demand for gas is

considerably higher than the amount that can be supplied. Hence, gas is rationed by prohibitions on hook-ups for new homes in many areas.

Gas is not only in short supply, but its allocation across the country is distorted, and its distribution among end-uses is unsatisfactory. Federal regulation of the wellhead price of natural gas in interstate commerce has discouraged its distribution from gas producing States to other States, and has encouraged consumption of this premium fuel for less essential uses. Industry and utilities currently consume almost 60 percent of U.S. natural gas, despite the fact that other fuels could be used in a majority of cases.

During the 1973-75 period, only 19 percent of new gas reserve additions were made available to the interstate market, and much of that gas was from the Federal domain. Since the price of intrastate gas is not regulated, there are strong economic incentives to sell gas within the producing States. *The existing distinction between intrastate and interstate sales has given intrastate users first claim to natural gas.*

Strategies and Objectives

The U.S. has three overriding energy objectives:

- as an immediate objective that will become even more important in the future, to reduce dependence on foreign oil and vulnerability to supply interruptions;
- in the medium term, to keep U.S. imports sufficiently low to weather the period when world oil production approaches its capacity limitation; and
- in the long term, to have renewable and essentially inexhaustible sources of energy for sustained economic growth.

The U.S. and the world are at the early stage of an energy transition. Previous energy transitions in the U.S. were stimulated by new technologies, such as the development of the railroad and the mass production of automobiles, which fostered the use of coal and oil, respectively. The latest transition springs from the need to adjust to scarcity and higher prices.

To make the new transition, the U.S. should adhere to basic principles that establish a sound context for energy policy and provide its main guidelines. The energy crisis must be addressed comprehensively by the Government and by a public that understands its seriousness and is willing to make necessary sacrifices. Economic growth with high levels of employment and production must be maintained. National policies for the protection of the environment must be continued. Above all, the U.S. must solve its energy problems in a manner that is fair to all regions, sectors and income groups.

The salient features of the National Energy Plan are:

- conservation and fuel efficiency;
- rational pricing and production policies;
- reasonable certainty and stability in Government policies;

- substitution of abundant energy resources for those in short supply; and
- development of nonconventional technologies for the future.

Conservation and fuel efficiency are the cornerstone of the proposed National Energy Plan. Conservation is cheaper than production of new supplies, and is the most effective means for protection of the environment. It can contribute to international stability by moderating the growing pressure on world oil resources. Conservation and improved efficiency can lead to quick results. For example, a significant percentage of poorly insulated homes in the United States could be brought up to strict fuel-efficiency standards in less time than it now takes to design, build, and license one nuclear powerplant.

Although conservation measures are inexpensive and clean compared with energy production and use, they do sometimes involve sacrifice and are not always easy to implement. If automobiles are to be made lighter and less powerful, the American people must accept sacrifices in comfort and horsepower. If industry is required to make energy-saving investments and to pay taxes for the use of scarce resources, there will be some increases in the cost of consumer products. These sacrifices, however, need not result in major changes in the American way of life or in reduced standards of living. Automobile fuel efficiency can be greatly improved through better design and use of materials, as well as by producing lighter and less powerful cars, without inhibiting Americans' ability to travel. With improved energy efficiency, the impact of rising energy prices can be significantly moderated.

Energy conservation, properly implemented, is fully compatible with economic growth, the development of new industries, and the creation of new jobs for American workers. Energy consumption need not be reduced in absolute terms; what is necessary is a slowing down in its rate of growth. By making adjustments in energy consumption now, the U.S. can avoid a possibly severe economic recession in the mid 1980's.

The U.S. has a clear choice. If a conservation program begins now, it can be carried out in a rational and orderly manner over a period of years. It can be moderate in scope, and can apply primarily to capital goods, such as homes and automobiles. If, however, conservation is delayed until world oil production approaches its capacity limitation, it will have to be carried out hastily under emergency conditions.

It will be sudden, and drastic in scope; and because there will not be time to wait for incremental changes in capital stock, conservation measures will have to cut much more deeply into patterns of behavior, disrupt the flow of goods and services, and reduce standards of living.

Pricing policies should encourage proper responses in both the consumption and the production of energy, without creating any windfall profits. *If users pay yesterday's prices for tomorrow's energy, U.S.*

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resources will be rapidly exhausted. If producers were to receive tomorrow's prices for yesterday's discoveries, there would be an inequitable transfer of income from the American people to the producers, whose profits would be excessive and would bear little relation to actual economic contribution.

Currently, Federal pricing policy encourages overconsumption of the scarcest fuels by artificially holding down prices. If, for example, the cost of expensive foreign oil is averaged with cheaper domestic oil, consumers overuse oil, and oil imports are subsidized and encouraged. Consumers are thus misled into believing that they can continue to obtain additional quantities of oil at less than its replacement cost.

Artificially low prices for some energy sources also distort interfuel competition. The artificially low price of natural gas, for example, has encouraged its use by industry and electric utilities, which could use coal, and in many areas has made gas unavailable for new households, which could make better use of its premium qualities.

These misguided Government policies must be changed. But neither Government policy nor market incentives can improve on nature and create additional oil or gas in the ground. From a long-term perspective, prices are an important influence on production and use. As long as energy consumers are misled into believing they can obtain energy cheaply, they will consume energy at a rate the U.S. cannot afford to sustain. Their continued overuse will make the nation's inevitable transition more drastic and difficult.

A national energy policy should encourage production. The energy industries need adequate incentives to develop *new* resources and are entitled to sufficient profits for exploration for *new* discoveries. But they should not be allowed to reap large windfall profits as a result of circumstances unrelated to the marketplace or their risk-taking.

The fourfold increase in world oil prices in 1973-74 and the policies of the oil-exporting countries should not be permitted to create unjustified profits for domestic producers at consumer's expense. By raising the world price of oil, the oil-exporting countries have increased the value of American oil in existing wells. That increase in value has not resulted from free market forces or from any risk-taking by U.S. producers. *National energy policy should capture the increase in oil value for the American people.* The distribution of the proceeds of higher prices among domestic producers and consumers must be equitable and economically efficient if the United States is to spread the cost fairly across the population and achieve its energy goals.

The pricing of oil and natural gas should reflect the economic fact that the true value of a depleting resource is the cost of replacing it. An effective pricing system would provide the price incentives that producers of oil and natural gas need by focusing on harder to find new supplies. The system should also moderate the adjustment that households will have to make to rising fuel costs. It should end

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the distortions of the intrastate-interstate distinction for new natural gas, which is a national resource. It should also promote conservation by raising the ultimate price of products made by energy-intensive processes.

Reasonable certainty and stability in Government policies are needed to enable consumers and producers of energy to make investment decisions. A comprehensive national energy plan should resolve a wide range of uncertainties that have impeded the orderly development of energy policy and projects. Some uncertainties are inherent in a market economy, and Government should not shelter industry from the normal risks of doing business. But Government should provide business and the public with a clear and consistent statement of its own policies, rules, and intentions so that intelligent private investment decisions can be made.

Resources in plentiful supply should be used more widely as part of a process of moderating use of those in short supply. Although coal comprises 90 percent of United States total fossil fuel reserves, the United States meets only 18 percent of its energy needs from coal. Seventy-five percent of energy needs are met by oil and natural gas although they account for less than 8 percent of U.S. reserves. This imbalance between reserves and consumption should be corrected by shifting industrial and utility consumption from oil and gas to coal and other abundant energy sources.

As industrial firms and utilities reduce their use of oil and gas, they will have to turn to coal and other fuels. The choices now for electric utilities are basically coal and nuclear power. Expanding future use of coal will depend in large part on the introduction of new technologies that permit it to be burned in an environmentally acceptable manner, in both power plants and factories. Efforts should also be made to develop and perfect processes for making gas from coal.

Light-water nuclear reactors, subject to strict regulation, can assist in meeting the United States energy deficit. The 63 nuclear plants operating today provide approximately 10 percent of U.S. electricity, about 3 percent of total energy output. That contribution could be significantly increased. The currently projected growth rate of nuclear energy is substantially below prior expectations due mainly to the recent drop in demand for electricity, labor problems, equipment delays, health and safety problems, lack of a publicly accepted waste disposal program, and concern over nuclear proliferation. The Government should ensure that risks from nuclear power are kept as low as humanly possible, and should also establish the framework for resolving problems and removing unnecessary delays in the nuclear licensing process.

To the extent that electricity is substituted for oil and gas, the total amounts of energy used in the country will be somewhat larger

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due to the inherent inefficiency of electricity generation and distribution. But conserving scarce oil and natural gas is far more important than saving coal.

Finally, *the use of nonconventional sources of energy must be vigorously expanded*. Relatively clean and inexhaustible sources of energy offer a hopeful prospect of supplementing conventional energy sources in this century and becoming major sources of energy in the next. Some of these nonconventional technologies permit decentralized production, and thus provide alternatives to large, central systems. Traditional forecasts of energy use assume that nonconventional resources, such as solar and geothermal energy, will play only a minor role in the United States energy future. Unless positive and creative actions are taken by Government and the private sector, these forecasts will become self-fulfilling prophecies. Other technologies that increase the efficiency of energy use should also be encouraged, such as cogeneration, the simultaneous production of industrial process steam and electricity.

A national energy plan cannot anticipate technological miracles. Even so, nonconventional technologies are not mere curiosities. Steady technological progress is likely, breakthroughs are possible, and the estimated potential of nonconventional energy sources can be expected to improve. Some nonconventional technologies are already being used, and with encouragement their use will grow. Because nonconventional energy sources have great promise, the Government should take all reasonable steps to foster and develop them.

The National Energy Plan is based on this conceptual approach. It contains a practical blend of economic incentives and disincentives as well as some regulatory measures. It strives to keep Government intrusion into the lives of American citizens to a minimum. It would return the fiscal surpluses of higher energy taxes to the American people.

Finally, the Plan sets forth goals for 1985 which, although ambitious, can be achieved with the willing cooperation of the American people. These goals are:

- reduce the annual growth of total energy demand to below 2 percent;
- reduce gasoline consumption 10 percent below its current level;
- reduce oil imports from a potential level of 16 million barrels per day to 6 million, roughly one-eighth of total energy consumption;
- establish a Strategic Petroleum Reserve of 1 billion barrels;
- increase coal production by two-thirds, to more than 1 billion tons per year;
- bring 90 percent of existing American homes and all new buildings up to minimum energy efficiency standards; and
- use solar energy in more than 2½ million homes.

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The Plan would reverse the recent trend of ever-rising oil imports and ever-increasing American dependence on uncertain foreign sources of supply. It would prepare the United States for the time when the world faces a limitation on oil production capacity and consequent skyrocketing oil prices. It would achieve substantial energy savings through conservation and increased fuel efficiency, with minimal disruption to the economy, and would stimulate the use of coal in a manner consistent with environmental protection.

The United States is at a turning point. It can choose, through piecemeal programs and policies, to continue the current state of drift. That course would require no hard decisions, no immediate sacrifices, and no adjustment to the new energy realities. That course may, for the moment, seem attractive. But, with each passing day, the United States falls farther behind in solving its energy problems. Consequently, its economic and foreign policy position weakens, its options dwindle, and the ultimate transition to scarce oil supplies and much higher oil prices becomes more difficult. If the United States faces up to the energy problem now and adopts the National Energy Plan, it will have the precious opportunity to make effective use of time and resources before world oil production reaches its capacity limitation.

The energy crisis presents a challenge to the American people. If they respond with understanding, maturity, imagination, and their traditional ingenuity, the challenge will be met. Even the "sacrifices" involved in conservation will have their immediate rewards in lower fuel bills and the sense of accomplishment that comes with achieving higher efficiency. By preparing now for the energy situation of the 1980's, the U.S. will not merely avoid a future time of adversity. It will ensure that the coming years will be among the most creative and constructive in American history.

Summary of the National Energy Plan

Conservation

In the transportation sector, the Plan proposes the following major initiatives to reduce demand:

- a graduated excise tax on new automobiles with fuel efficiency below the fleet average levels required under current legislation; the taxes would be returned through rebates on automobiles that meet or do better than the required fleet averages and through rebates on all electric automobiles;
- a standby gasoline tax, to take effect if total national gasoline consumption exceeds stated annual targets; the tax would begin at 5 cents per gallon, and could rise to 50 cents per gallon in 10 years if targets were repeatedly exceeded by large or increasing amounts; the tax would decrease if a target were met; taxes collected would be returned to the public through the income tax system and transfer payment programs; States would be compensated for lost gasoline tax revenues through sources such as the Highway Trust Fund;
- fuel efficiency standards and a graduated excise tax and rebate system for light-duty trucks;
- removal of the Federal excise tax on intercity buses;
- increase in excise tax for general aviation fuel, and elimination of the existing Federal excise tax preference for motorboat fuel;
- improvement in the fuel efficiency of the Federal automobile fleet, and initiation of a vanpooling program for Federal employees.

To reduce waste of energy in existing buildings, the Plan proposes a major program containing the following elements:

- a tax credit of 25 percent of the first \$800 and 15 percent of the next \$1,400 spent on approved residential conservation measures;
- a requirement that regulated utilities offer their residential customers a "turnkey" insulation service, with payment to be made through monthly bills; other fuel suppliers would be encouraged to offer a similar service;
- facilitating residential conservation loans through opening of a secondary market for such loans;
- increased funding for the current weatherization program for low-income households;

- a rural home conservation loan program;
- a 10 percent tax credit (in addition to the existing investment tax credit) for business investments in approved conservation measures;
- a Federal grant program to assist public and non-profit schools and hospitals to insulate their buildings;
- inclusion of conservation measures for State and local government buildings in the Local Public Works Program.

The development of mandatory energy efficiency standards for new buildings will be accelerated. In addition, the Federal Government will undertake a major program to increase the efficiency of its own buildings.

The Plan proposes the establishment of mandatory minimum energy efficiency standards for major appliances, such as furnaces, air conditioners, water heaters, and refrigerators.

The Plan proposes to remove major institutional barriers to cogeneration, the simultaneous production of process steam and electricity by industrial firms or utilities, and to provide an additional 10 percent tax credit for investment in cogeneration equipment. Encouragement will also be given to district heating, and the Energy Research and Development Administration (ERDA) will undertake a study to determine the feasibility of a district heating demonstration program at its own facilities.

To promote further industrial conservation and improvements in industrial fuel efficiency, an additional 10 percent tax credit for energy-saving investments would be available for certain types of equipment (including equipment for use of solar energy) as well as conservation retrofits of buildings.

The Plan also contains a program for utility reform, with the following elements:

- a phasing out of promotional, declining block, and other electric utility rates that do not reflect cost incidence; declining block rates for natural gas would also be phased out;
- a requirement that electric utilities either offer daily off-peak rates to customers willing to pay metering costs or provide a direct load management system;
- a requirement that electric utilities offer customers interruptible service at reduced rates;
- a prohibition of master metering in most new structures;
- a prohibition of discrimination by electric utilities against solar and other renewable energy sources;
- Federal authority to require additional reforms of gas utility rates;
- Federal Power Commission (FPC) authority to require interconnections and power pooling between utilities even if they are not now subject to FPC jurisdiction, and to require wheeling.

Oil and Natural Gas

Government policy should provide for prices that encourage development of new fields and a more rational pattern of distribution; but it should also prevent windfall profits. It should promote conservation by confronting oil and gas users with more realistic prices, particularly for those sectors of the economy where changes can be made without hardship. To promote these ends, the Plan proposes a new system for pricing oil and natural gas.

The proposal for oil pricing contains the following major elements:

- price controls would be extended;
- newly discovered oil would be allowed to rise over a 3 year period to the 1977 world price, adjusted to keep pace with the domestic price level; thereafter, the price of newly discovered oil would be adjusted for domestic price increases;
- the incentive price for "new oil" would be applicable to oil produced from an onshore well more than 2½ miles from an existing well, or from a well more than 1,000 feet deeper than any existing well within a 2½ mile radius; the incentive price would be applicable to oil from Federal offshore leases issued after April 20, 1977;
- the current \$5.25 and \$11.28 price ceilings for previously discovered oil would be allowed to rise at the rate of domestic price increases;
- stripper wells and incremental tertiary recovery from old fields would receive the world price;
- all domestic oil would become subject in three stages to a crude oil equalization tax equal to the difference between its controlled domestic price and the world oil price; the tax would increase with the world price, except that authority would exist to discontinue an increase if the world price rose significantly faster than the general level of domestic prices;
- net revenues from the tax would be entirely returned to the economy: residential consumers of fuel oil would receive a dollar-for-dollar rebate, and the remaining funds would be returned to individuals through the income tax system and transfer payment programs;
- once the wellhead tax is fully in effect, the entitlements program would be terminated, along with certain related activities, but would be retained on a standby basis.

The proposal for natural gas pricing contains the following major provisions:

- all new gas sold anywhere in the country from new reservoirs would be subject to a price limitation at the Btu equivalent of the average refiner acquisition cost (before tax) of all domestic crude oil;

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- that price limitation would be approximately \$1.75 per thousand cubic feet (Mcf) at the beginning of 1978; the interstate-intrastate distinction would disappear for new gas;
- new gas would be defined by the same standards used to define new oil;
- currently flowing natural gas would be guaranteed price certainty at current levels, with adjustments to reflect domestic price increases;
- authority would exist to establish higher incentive pricing levels for specific categories of high-cost gas, for example, from deep drilling, geopressurized zones and tight formations;
- gas made available at the expiration of existing interstate contracts or by production from existing reservoirs in excess of contracted volumes would qualify for a price no higher than the current \$1.42 per Mcf ceiling; gas made available under the same circumstances from existing intrastate production would qualify for the same price as new gas;
- the cost of the more expensive new gas would be allocated initially to industrial rather than residential or commercial users;
- Federal jurisdiction would be extended to certain synthetic natural gas facilities;
- taxes would be levied on industrial and utility users of oil and natural gas to encourage conservation and conversion to coal or other energy sources.

The Plan contains the following additional proposals for oil and natural gas:

- to encourage full development of the oil resources of Alaska, Alaskan oil from existing wells would be subject to the \$11.28 upper tier wellhead price and would be treated as uncontrolled oil for purposes of the entitlements program; new Alaskan oil finds would be subject to the new oil wellhead price;
- production from Elk Hills Naval Petroleum Reserve would be limited to a ready reserve level at least until the west-to-east transportation systems for moving the surplus Alaskan oil are in place or until California refineries have completed a major retrofit program to enable more Alaskan oil to be used in California;
- the Outer Continental Shelf Lands Act would be amended to require a more flexible leasing program using bidding systems that enhance competition, to assure a fair return to the public, and to assure full development of the OCS resources;
- shale oil will be entitled to the world oil price;
- the guidelines established by the Energy Resources Council in the previous administration would be replaced by a more flexible policy: projects for importation of liquefied natural gas

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(LNG) should be analyzed on a case-by-case basis with respect to the reliability of the selling country, the degree of American dependence the project would create, the safety conditions associated with any specific installation and all costs involved; imported LNG would not be concentrated in any one region; new LNG tanker docks would be prohibited in densely populated areas;

- Federal programs for development of gas from geopressurized zones and Devonian shale would be expanded;
- the Administration hopes to eliminate gasoline price controls and allocation regulations next fall; to maintain competition among marketers, it supports legislation similar to the pending “dealer day in court” bill;
- as part of the extension of oil and natural gas price controls, the Administration would urge that independent producers receive the same tax treatment of intangible drilling costs as their corporate competitors;
- a Presidential Commission will study and make recommendations concerning the national energy transportation system.

To provide relative invulnerability from another interruption of foreign oil supply, the Strategic Petroleum Reserve will be expanded to 1 billion barrels; efforts will be made to diversify sources of oil imports; contingency plans will be transmitted to the Congress; and development of additional contingency plans will be accelerated.

Coal

Conversion by industry and utilities to coal and other fuels would be encouraged by taxes on the use of oil and natural gas.

The Plan also contains a strong regulatory program that would prohibit all new utility and industrial boilers from burning oil or natural gas, except under extraordinary conditions. Authority would also exist to prohibit the burning of oil or gas in new facilities other than boilers. Existing facilities with coal-burning capability would generally be prohibited from burning oil and gas. Permits would be required for any conversion to oil or gas rather than to coal. By 1990, virtually no utilities would be permitted to burn natural gas.

While promoting greater use of coal, the Administration will seek to achieve continued improvement in environmental quality. A strong, but consistent and certain, environmental policy can provide the confidence industry needs to make investments in energy facilities. The Administration's policy would:

- require installation of the best available control technology in all new coal-fired plants, including those that burn low sulfur coal;

- protect areas where the air is still clean from significant deterioration;
- encourage States to classify lands to protect against significant deterioration within 3 years after enactment of Clean Air Act amendments;
- require Governors to announce intent to change the classification of allowable air quality for a given area within 120 days after an application is made to construct a new source in that area;
- require States to approve or disapprove the application within 1 year thereafter.

Further study is needed of the Environmental Protection Agency's policies allowing offsetting pollution trade-offs for new installations. A committee will study the health effects of increased coal production and use, and the environmental constraints on coal mining and on the construction of new coal-burning facilities. A study will also be made of the long-term effects of carbon dioxide from coal and other hydrocarbons on the atmosphere.

The Administration supports uniform national strip mining legislation.

An expansion is proposed for the Government's coal research and development program. The highest immediate priority is development of more effective and economic methods to meet air pollution control standards. The program will include research on:

- air pollution control systems;
- fluidized bed combustion systems;
- coal cleaning systems;
- solvent refined coal processes;
- low Btu gasification processes;
- advanced high Btu gasification processes;
- synthetic liquids technology;
- coal mining technology.

Nuclear Power

It is the President's policy to defer any U.S. commitment to advanced nuclear technologies that are based on the use of plutonium while the United States seeks a better approach to the next generation of nuclear power than is provided by plutonium recycle and the plutonium breeder. The U.S. will defer indefinitely commercial reprocessing and recycling of plutonium. The President has proposed to reduce the funding for the existing breeder program, and to redirect it toward evaluation of alternative breeders, advanced converter reactors, and other fuel cycles, with emphasis on nonproliferation and safety concerns. He has also called for cancellation of construction of the Clinch River Breeder Reactor Demonstration Project and all component construction, licensing, and commercialization efforts.

To encourage other nations to pause in their development of plutonium-based technology, the United States should seek to restore confidence in its willingness and ability to supply enrichment services. The United States will reopen the order books for U.S. uranium enrichment services, and will expand its enrichment capacity by building an energy-efficient centrifuge plant. The President is also proposing legislation to guarantee the delivery of enrichment services to any country that shares U.S. nonproliferation objectives and accepts conditions consistent with those objectives.

To resolve uncertainties about the extent of domestic uranium resources, ERDA will reorient its National Uranium Resources Evaluation Program to improve uranium resource assessment. The program will also include an assessment of thorium resources.

The United States has the option of relying on light-water reactors to provide nuclear power to meet a share of its energy deficit. To enhance the safe use of light-water reactors:

- the Nuclear Regulatory Commission (NRC) has already increased the required number of guards at nuclear plants and the requirements for the training that guards receive;
- the President is requesting that the NRC expand its audit and inspection staff to increase the number of unannounced inspections and to assign one permanent Federal inspector to each nuclear power plant;
- the President is requesting that the Commission make mandatory the current voluntary reporting of minor mishaps and component failures at operating reactors;
- the President is requesting that the NRC develop firm siting criteria with clear guidelines to prevent siting of nuclear plants in densely populated locations, in valuable natural areas, or in potentially hazardous regions.

The President has directed that a study be made of the entire nuclear licensing process. He has proposed that reasonable and objective criteria be established for licensing and that plants which are based on a standard design not require extensive individual licensing.

To ensure that adequate waste storage facilities are available by 1985, ERDA's waste management program has been expanded to include development of techniques for long-term storage of spent fuel. Also, a task force will review ERDA's waste management program. Moreover, improved methods of storing spent fuel will enable most utilities at least to double their current storage capacity without constructing new facilities.

Hydroelectric Power

The Department of Defense (Corps of Engineers), together with other responsible agencies, will report on the potential for installation

of additional hydroelectric generating capacity at existing dams throughout the country.

Nonconventional Resources

America's hope for long-term economic growth beyond the year 2000 rests in large measure on renewable and essentially inexhaustible sources of energy. The Federal Government should aggressively promote the development of technologies to use these resources.

Solar Energy

Solar hot water and space heating technology is now being used and is ready for widespread commercialization. To stimulate the development of a large solar market, a tax credit is proposed. The credit would start at 40 percent of the first \$1,000 and 25 percent of the next \$6,400 paid for qualifying solar equipment. The credit would decline in stages to 25 percent of the first \$1,000 and 15 percent of the next \$6,400. The credit would be supported by a joint Federal-State program of standards development, certification, training, information gathering, and public education. Solar equipment used by business and industry would be eligible for an additional 10 percent investment tax credit for energy conservation measures.

Geothermal Energy

Geothermal energy is a significant potential energy source. The tax deduction for intangible drilling costs now available for oil and gas drilling would be extended to geothermal drilling.

Research, Development and Demonstration

An effective Federal research, development and demonstration program is indispensable for the production of new energy sources. The Federal Government should support many research options in their early stages, but continue support into the later stages only for those that meet technical, economic, national security, health, safety, and environmental criteria. Research and development should be accompanied by preparation for commercialization so that successful projects can rapidly be put to practical use.

Additional research, development and demonstration initiatives are proposed, with emphasis on small, dispersed and environmentally sound energy systems.

An Office of Small-Scale Technologies would be established to fund small, innovative energy research and development projects. The office would enable individual inventors and small businesses to contribute to the national energy research and development effort.

Information

A three-part energy information program is proposed. A Petroleum Production and Reserve Information System would provide the Federal Government with detailed, audited data on petroleum reserve esti-

mates and production levels. A Petroleum Company Financial Data System would require all large companies and a sample of small firms engaged in crude oil or natural gas production to submit detailed financial information to the Federal Government. Data required from integrated companies would permit evaluation of the performance of their various segments by providing vertical accountability. An Emergency Management Information System would provide the Federal and State governments with information needed to respond to energy emergencies.

Competition

Effective competition in the energy industries is a matter of vital concern. The Under Secretary for policy and evaluation in the proposed Department of Energy would be responsible for making certain that policies and programs of the Department promote competition. Although at this time it does not appear necessary to proceed with new legislation for either horizontal or vertical divestiture of the major oil companies, their performance will be monitored. The proposed information program would greatly assist that effort.

A present anomaly in the availability of the tax deduction for intangible drilling costs within the oil industry would be removed as part of the program for extending oil and natural gas price controls.

Emergency Assistance for Low-Income Persons

Existing emergency assistance programs are deficient in assisting low-income persons to meet sharp, temporary increases in energy costs due to shortages or severe winters. A redesigned program will be completed promptly and submitted to the Congress.

Chapter I.—The Origins of the U.S. Energy Problem

Abundant, cheap energy has been a decisive element in the creation of modern America. Since the industrial revolution, fossil energy has increasingly replaced human labor in the workplace, supported a growing population, and led to a spectacular growth in productivity and higher standards of living for Americans. Today, the entire stock of capital goods—from poorly insulated buildings to heavy and powerful automobiles—is tailored to plentiful and cheap energy.

But the days of abundance are now drawing to a close, and American society faces sobering new energy realities. Domestic reserves of oil and natural gas, the nation's predominant energy sources since World War II, have been declining since 1970. Imported oil and other possible substitutes for oil and gas are now expensive. As a result, the available supply of cheap oil and gas is being rapidly exhausted, and consumption of them cannot continue to grow at the pace to which Americans have become accustomed. Fundamental changes in the supply and cost of oil and gas will reshape the United States during the remainder of this century.

Today, America's primary source of energy is oil, which provides nearly half the energy consumed and is used in all sectors of the economy. Oil was developed originally as a source of artificial light and as a lubricant. In the 1870's and 1880's, illumination from new forms of gas manufactured from coal began to appear, and Edison invented the incandescent light. By the outbreak of World War I, industrial and residential heating had become the principal use of oil.

In the early years of this century, the age of the mass-produced automobile—and the age of oil—really began. The number of registered automobiles increased from 8,000 in 1900 to over 1 million in 1913, 10 million in 1922, and 27.5 million in 1940. American oil production rose from 64 million barrels in 1900 to 1.4 billion barrels in 1940. By 1950, oil had replaced coal as the predominant energy source in the United States.

Demand for natural gas followed a similar course. Gas was originally a discarded by-product of oil extraction, but its consumption grew with the development of pipeline systems that could deliver it cheaply to nationwide markets.

Between 1945 and 1960, gas became the predominant fuel for residential heating, and began to replace oil and coal as a boiler fuel for industry and electric utilities. Its cleanness and extremely low

price induced both industrial and residential users to switch from coal and become heavily dependent on natural gas. Today, natural gas meets about one-fourth of U.S. energy needs.

During the period from 1950 to 1970, the real cost of energy in the United States decreased 28 percent. Much of the decrease resulted from declining real prices for oil imports, which grew from 900,000 barrels per day in 1950 to 3.4 million barrels per day in 1970. The expansion of imports was made possible by new production from large reservoirs of oil overseas, and by the development of an efficient, economic international oil transportation system.

During the two decades of falling real energy prices, America's gross national product rose an unprecedented 102 percent or 3.6 percent per year, and domestic energy consumption grew at an average annual rate of 3.5 percent, for a total increase of 98 percent. The effects of increased affluence and energy demand were felt throughout society, as Americans in homes, farms, factories, and offices turned to energy-consuming machines and appliances for liberation from daily drudgery.

Buildings generally were constructed with little or no insulation or regard for energy-saving design. Air-conditioners became commonplace. Automobile weight and horsepower increased. Cheap automobile transportation helped to shape major metropolitan areas with widely distributed suburban development and inadequate mass transportation. Petroleum-based plastics and textiles replaced many natural fibers, wood, and other materials. Wider use of electricity resulted in generally less efficient use of oil, gas, and coal because three units of primary energy are consumed in the generation and transmission of every unit of electrical energy. During the entire post-war period—until the quadrupling of world oil prices in 1973-74—almost all economic and technological developments were premised on cheap energy, while the costs of other factors of production increased.

Today, America consumes far more energy than any other nation. With less than 6 percent of the world's population, the United States consumes more than 30 percent of the world's energy. As Figure I-1 shows, the United States uses more energy per dollar of gross national product than any other industrialized nation. America consumes twice as much energy per capita as West Germany, which has a similar standard of living.

America's rapidly growing demand for energy has not resulted entirely from broad economic and social developments. With some exceptions, such as the restrictions on oil imports during the period when foreign oil was cheap, Government policies have generally stimulated energy demand. Tax benefits to producers and regulation of prices to consumers have kept the price of energy below its true replacement cost, and thereby promoted consumption and waste.

Energy Consumption Per Unit of GNP

Source of Data: U.N. Statistical Yearbook, 1975

Figure I-1

Large-volume consumers of electricity and natural gas have been given discounts. Government policy has subsidized and protected energy-inefficient truck and air transportation. The interstate highway system has encouraged automobile use. Local highways have drawn people, businesses, and industry out of central cities into suburbia. Thus, the American people have been led to believe that the oil and gas they consume will remain cheap, when in fact new additions to oil and gas supply already are expensive and inevitably will become more so.

Compound growth of demand for energy can produce striking results within a surprisingly short time. If demand for energy increases at the long-term annual average of 3 percent, it doubles in 24 years. Compound growth at an annual average of 4.3 percent, the rate prevailing from 1963 to 1973, would double energy consumption in 16 years. At 7 percent, the rate at which electricity consumption grew during the 1960's, energy consumption would double in 10 years. The difference between a U.S. growth rate of 3.5 percent (the 1950-73 average) and a growth rate of 2.3 percent (the 1968-76 average) would result in the consumption of 20 million additional barrels of oil equivalent per day in the year 2000.¹ (See Figure I-2.) That would be an increment of more than one-half of total 1976 daily energy consumption.

The domestic sources of energy which have largely satisfied growing U.S. demand since World War II are declining. U.S. oil production has been falling since 1970. Alaskan oil will boost U.S. production for a few years; but then, without significant new discoveries, production will decline or remain static. World production of oil is likely to approach its capacity limitation by the mid-1980's, so the United States cannot look to an expanding supply of imported oil as it has in the past. U.S. natural gas production has been declining since 1973. In sum, the supplies of oil and natural gas now available to the United States cannot possibly serve to sustain continued growth of demand at rates like those of recent years.

America is now at an historic turning point as the postwar era of oil and gas comes to a close. America has made two major energy transitions in the past, but in very different circumstances (see Figure I-3). After the Civil War, wood, waterwheels, and windmills largely gave way to coal. Although these resources were abundant, technological progress made it feasible and more economical to use coal in railroad transportation, for industrial process heat, and for home heating. Coal supplied more than half of U.S. energy needs from about 1885 to about 1940. During the 1950's, the transition from coal to oil and

¹ Throughout this report, quantities of energy are expressed in terms of barrels of oil (petroleum product) per day. One million barrels of oil per day equals 1.96 trillion cubic feet of natural gas per year, or 88 million tons of coal per year.

A Lower Growth Rate Can Make A Large Difference In Energy Requirements

Figure 1-2

The United States Has Shifted to Different Fuel Use Patterns

natural gas was completed, and they became America's predominant energy sources. This second transition, from one abundant fuel to two others, also resulted from technological progress, as well as the lower cost, cleanness, and ease of handling of oil and natural gas. The transition did not result from any shortage of coal, which even today is a vast resource.

The energy crisis that now faces America results from the divergence between its historically increasing energy demand and its decreasing supplies of oil and natural gas. To meet this crisis, America must make a new kind of energy transition—from a period of abundant, cheap oil and gas to a period when these resources will be in short supply.

Historically, the United States has depended on technological progress to solve many of its problems. There is hope that technological developments will provide long-term solutions to the energy problem. But, in the energy field, technologies develop slowly. Someday, the U.S. probably will be able to rely on such abundant resources as solar energy, geothermal energy, and, perhaps, fusion; but, even under the most optimistic estimates, those resources will not become major suppliers of energy until after the year 2000. America landed a man on the moon in a decade, but finding substitutes for oil and natural gas is a far more difficult and time-consuming job that must be accomplished within economic, social, health and environmental constraints.

The coming energy transition can be made in three stages. In the short term, from now until 1985, the United States can reduce its rate of growth of demand for energy generally and for oil in particular, reallocate natural gas to high priority uses, increase the use of abundant conventional energy sources, and build up the Strategic Petroleum Reserve to protect against another interruption of foreign oil supply. During this period, the U.S. stock of capital goods can be adjusted to the new realities of scarcity. By the mid-1980's, when world oil production is likely to approach its capacity limitation, the United States could be in a position to reduce its demand for foreign oil. Beyond 2000, the United States will need new energy sources to maintain economic growth and a high standard of living.

If America takes action now, it can accomplish the transition in an orderly way. With sufficient time, the U.S. can modify its capital stock to make it more efficient. However, if action is delayed, the transition will have to be made abruptly with measures, such as rationing, that operate directly on behavior and at the expense of the immediate flow of goods and services.

Chapter II.—The Continuing Crisis

Another sudden quadrupling of the world price of oil, like that in 1973-74, is improbable. Although the danger of another interruption of oil imports is real, there does not appear to be any immediate prospect of one. Another winter as cold as the last does not seem likely.

In the absence of energy traumas, it is easy to forget. But the real energy crisis does not lie in intermittent supply interruptions or shortages during abnormally cold winters. These are simply dramatic symptoms of the underlying conditions of energy demand and supply that are worsening slowly, but inexorably, day by day.

This invisible crisis arises from the pressure of growing demand on finite resources of oil and natural gas. Over time, economic growth and increases in population add large increments to an already large base of consumption. However, the resources from which the demand must be satisfied are limited.

In the short run, the growing gap between consumption and domestic supply will have to be filled by increasing oil imports unless effective actions are taken to reduce demand and increase domestic supply. Import dependence produces economic and political vulnerability. The energy demand of other nations is also growing, and world oil production is likely to approach its capacity limitation in the near future. Thus, even if the United States were willing to accept the consequences of increasing dependence on imports, in the future the world's oil supply will no longer be able to satisfy growing American demand.

In the long term, research and development will provide supply options not available now. Until then, the basic task for the American people is to adjust energy consumption patterns to reduce pressure on domestic oil and gas resources and reduce oil imports. Thereby, the U.S. would be prepared for the transition to a different energy economy at the beginning of the next century.

U.S. ENERGY DEMAND

Econometric projections of supply and demand are made by Government and industry to analyze the impacts of different actions and policies. These projections are based on mathematical simulation of past behavior. As such, they fail to take into account the changing na-

ture of public attitudes and tastes, institutional constraints, and many other factors. A mathematical model was used in the development of the National Energy Plan to provide one type of estimate of what would happen with and without the Plan. However, due to the inherent limitations of all models, care has been taken to set forth the uncertainties surrounding particular projections, and judgment has been exercised in order to provide the most reliable picture of America's energy future, both with and without the Plan.

The President's economic goals imply a 46 percent increase in gross national product (GNP) by 1985. Although there is no fixed relationship between energy and GNP, this growth does imply a substantial increase in energy consumption unless effective conservation measures are taken.

The model projects that, with a high rate of economic growth and no new conservation initiatives, total U.S. energy demand would grow between 1976 and 1985 at an average annual rate of 3 percent. Consumption would rise from the equivalent of 37 million barrels of oil per day in 1976 to more than 48 million by 1985, a 31 percent increase. Under favorable assumptions and with no new initiatives, domestic energy supply is projected to increase from the equivalent of 30 million barrels of oil per day in 1976 to 37 million in 1985. Thus, the overall gap between demand and domestic production would grow from 7 million barrels of oil equivalent per day to about 12 million.¹

These projections could be unduly optimistic: they could understate demand and overstate domestic supply. If Americans disregard the energy crisis, demand could easily increase at a rate higher than projected; and experience suggests that domestic supply could easily be below the projected level.

Energy consumption is projected to grow at different rates in the three sectors of the economy from 1976 to 1985. The industrial sector's consumption of energy, 37 percent of the total in 1976, is projected to increase the most, by more than 5 percent per year. Residential and commercial demand, also 37 percent in 1976, is projected to increase at an average annual rate of about 2 percent. Transportation demand, 26 percent in 1976, is projected to increase at an average annual rate of 1 percent, assuming successful implementation of the present fuel efficiency standards and driver response to higher gasoline prices.

These projected growth rates are substantially different from those of the recent past. From 1950 to 1973, when energy consumption increased at an average annual rate of 3.5 percent, industrial use rose at a rate of only 3.0 percent; residential and commercial use grew at a rate of 4.3 percent; and use in the transportation sector grew

¹The numbers do not add up due to rounding.

at a rate of 3.4 percent. Since the 1973-74 embargo, energy use by industry has actually decreased, and energy use in the residential and commercial sector and the transportation sector has increased only slightly.

In addition to considering total demand and the demand of individual sectors, it is important to recognize that the various energy sources have different qualities and ranges of use and are more valuable in some uses than in others. Oil is heavily used by all three sectors, but is needed most for the transportation sector, where no substitute is currently available. Although natural gas is heavily used by industry, it is the premium fuel for residential and commercial use because it is an efficient, clean, and convenient source of heat. Coal is used principally by electric utilities and industry, and nuclear energy is suitable only for electricity generation. (Figure II-1 shows the fuels used by each sector.)

Substantial opportunities exist for reducing demand in all sectors. In the transportation sector, large savings can be achieved by improving the efficiency of automobiles and trucks. Sizable savings are also attainable in the industrial sector through more efficient processes and other energy-saving measures. With better insulation of homes and more efficient appliances, significant savings can be made in the residential sector.

OIL

Oil is the nation's major energy source, but neither domestic supplies nor imports from the rest of the world will be able to satisfy indefinitely continued high rates of growth.

Since World War II, U.S. oil consumption grew at an average annual rate of 4.4 percent until 1973. From 1969 to 1973, utilities and industrial users of coal responded to increased environmental concerns by converting to oil and natural gas. OPEC's fourfold increase in oil prices in 1973-74 created an immediate incentive for conservation. Consumption fell during the 1973-75 recession, but has now resumed its upward trend, and grew 6.7 percent in 1976.

Without further action, U.S. demand for oil will continue to increase in the future (see Figure II-2). Even taking into account various constraints, the mathematical model projects that demand will rise from 17.4 million barrels per day in 1976 to 22.8 million in 1985, a 3 percent annual increase. Without constraints, U.S. oil demand probably would grow at the postwar rate of 4 percent per year, and reach 25 million barrels per day by 1985.

Domestic oil supply cannot possibly meet that growing demand. Domestic oil reserves constitute only 3.7 percent of U.S. conventional energy reserves, but provided 27 percent of U.S. energy consumption in 1976. Current domestic production is 10 million barrels per day.²

² Including natural gas liquids (NGL's) and refinery gains.

U.S. Energy Consumption By Sector, 1976

*Oil Equivalent
(Electricity Losses Allocated)
Source: Federal Energy Administration.

Figure II-1

* Includes Natural Gas Liquids

** assumes implementation of mandatory fuel efficiency standards and reductions induced by higher gasoline prices

Source: U.S. Bureau of Mines and Federal Energy Administration.

Figure II-2

With rising prices, the model projects total U.S. production of around 11 million barrels per day in 1985,^a assuming a new contribution of about 3 million barrels per day from Alaskan oil, Outer Continental Shelf development, and tertiary recovery. Nevertheless, these new sources will be far from sufficient to satisfy the projected growth in U.S. demand.

Other major additions to domestic oil supply are unlikely. For more than 17 years, domestic oil discoveries have been outpaced by domestic consumption, except for the discovery of oil on the North Slope of Alaska. In 1940, U.S. proved reserves were sufficient for 14 years of consumption. Today, U.S. proved reserves amount to less than 10 years of production at the current level, which is only 5 years of current total domestic oil consumption. In the face of falling domestic oil reserves and production, oil companies increasingly engage in high-risk, high-cost development in such frontier areas as Alaska and the deep Outer Continental Shelf.

As a result of these postwar trends in demand and domestic supply, the United States has increasingly turned to imported oil. In 1947, the United States became a net importer of oil, but domestic excess production capacity exceeded the level of imports. By the mid-1960's, the United States had become dependent on imports: domestic excess capacity could no longer match the level of imports. Imports rose from 21 percent of U.S. oil consumption in 1965 to 37 percent in 1974. In 1976, imports averaged 7.3 million barrels per day, or 42 percent of U.S. oil consumption. In February of 1977, oil imports jumped to 9.6 million barrels per day. Increasing consumption of imported oil has led to deepening dependence on the world oil market and growing vulnerability to a supply interruption.

A major increase in imports will occur by 1985 unless demand is curbed. If demand for oil were to grow freely, it could reach 25 million barrels per day in 1985. Domestic oil production could well be only about 9 million barrels per day, 2 million below the model's projection. Oil imports would then be 16 million barrels per day. If current measures to increase fuel efficiency in automobiles are successful and if higher gasoline prices reduce driving, it is likely that demand for oil would be closer to 23 million barrels per day, and imports closer to 14 million. If, by 1985, demand were in fact 23 million barrels per day and domestic oil production were to increase by 1 million barrels per day, to 11 million, oil imports would then be 12 million barrels per day. Although estimates vary widely, the most reasonable range of estimates of 1985 oil imports is 12 to 16 million barrels per day.

Even apart from considerations of vulnerability, the United States cannot rely indefinitely on growing oil imports to meet its domestic deficit. In coming years, several factors will limit the availability of world oil for U.S. consumption. Ultimately, there are physical and

^a Including refinery gains.

economic limits on world oil resources. The approach to these limits will be hastened by increasing demand in other countries. During the 1980's, the oil-exporting countries will approach their capacity limitation.

The availability and cost of oil imports to the United States will be influenced by the rate of growth in demand for oil throughout the world. As the economies of other industrialized countries grow, their demand for world oil will increase. It is probable that, during the 1980's, demand for oil will outpace production in the Soviet Union and Eastern Europe, and their excess demand will aggravate the growing pressure on world oil supply. As developing countries make economic progress, they, too, will need additional oil. Iran, Venezuela, Nigeria, and other oil-exporting countries may well experience economic growth that will create substantial domestic demand for oil and cause them to limit exports, even if they maintain or increase production.

The oil-exporting countries probably will not be able to satisfy the increases in demand now projected to occur in the 1980's. In 1976, the 13 OPEC countries exported 29 million barrels of oil per day. If world demand continues to grow at the rates of recent years, by 1985 it could reach or exceed 50 million barrels per day. The United States alone, the most profligate of the world's energy users, would require a substantial part of that total. However, many OPEC countries cannot significantly increase production. In some, production will actually decline. Thus, as a practical matter, overall OPEC production could approach the expected level of world demand only if Saudi Arabia greatly increased its production. Even if Saudi Arabia did so, the highest levels of OPEC production probably would be inadequate to meet increasing world demand beyond the late 1980's or early 1990's.

Finally, there are physical and economic limits on the world's supply of oil. There is considerable uncertainty and debate about the size of the world's oil resources. A widely used geological estimate of total recoverable world oil resources, past and present, is about 2 trillion barrels. More than 360 billion barrels have already been consumed. Current proved crude reserves are 600 billion barrels. World demand for oil has grown at an average annual rate of 6.6 percent since 1940. It grew by as much as 8 percent annually during the 1960's. If it could be assumed that world demand for oil would grow at an annual rate of only 3 percent, and if it were possible (which it is not) that production would keep pace with that rate of growth, the world's estimated recoverable oil resources would be exhausted by 2020. At a conjectural growth rate of 5 percent, those resources would be exhausted by 2010.

In reality, world production would not continue to grow until the last drop was recovered. Rather, the growth of world consumption

would be stopped by limitations on productive capacity. Despite the uncertainty about the exact size of recoverable world oil resources and about the rate of increase in productive capacity, this fundamental fact is clear: within about four generations, the bulk of the world's supply of oil, created over hundreds of millions of years, will have been substantially consumed.

Of course, actual physical exhaustion of oil resources will not occur. Even today, well over half the oil in existing wells is left in the ground because additional recovery would be too expensive. As production by conventional methods declines and oil becomes more scarce, its price will rise and more expensive recovery methods and novel technologies will be used to produce additional oil. As this process continues, the price of oil will become prohibitive for most energy uses. Eventually, the nations of the world will have to seek substitutes for oil for most energy uses, and oil will have to be reserved for petrochemical and other uses in which it has maximum value.

The world now consumes over 20 billion barrels of oil per year. To maintain *even that rate of consumption* and keep reserves intact, the world would have to discover another Kuwait or Iran roughly every 3 years, or another Texas or Alaska roughly every 6 months. Although some large discoveries will be made, the likelihood of a continuous flow of large discoveries is small. Indeed, recent experience suggests that, from the perspective of world oil consumption, future discoveries will be small or moderate in size, will occur in frontier areas, and will yield oil only at very high cost. Obviously, continued high rates of *growth* of oil consumption simply cannot be sustained.

NATURAL GAS

The opportunities for supplementing domestic production of natural gas with imports are small. It is far more expensive to transport gas overseas than oil. The presently available supplements to domestic natural gas are limited amounts of Canadian gas, imported liquefied natural gas (LNG), and synthetic natural gas (SNG). The availability of Canadian gas is becoming increasingly uncertain, and LNG and SNG are very expensive. Therefore, the growing imbalance between America's domestic natural gas resources and its annual consumption is of particular concern. (see Figure II-3.)

Natural gas constitutes only 4 percent of domestic conventional energy reserves. In 1973 it furnished 30 percent of U.S. energy consumption, the equivalent of about 11.2 million barrels of oil per day.⁴ By 1976, its share had dropped to 27 percent, equivalent to 10 million barrels per day.

⁴ Excluding natural gas liquids.

¹does not include the effect of the National Energy Plan
Source: Federal Energy Administration.

Figure II-3

Gas consumption grew by about 5.7 percent per year between 1960 and 1970. From 1970 to 1974, however, consumption declined by 1.3 percent, mainly because declining production caused prohibitions against the use of gas in new homes and buildings, and because industrial and electric utility users of interstate natural gas could not obtain adequate long-term commitments for new supplies.

Domestic production of gas, having peaked at 22.2 trillion cubic feet in 1973, has been declining. Last year, only 19.0 trillion cubic feet were produced.

Between 1976 and 1985, total U.S. production of natural gas is projected by the model to decrease from the equivalent of 9.5 million barrels of oil per day to 8.2 million barrels. Consumption, however, is projected to be the equivalent of 9.4 million barrels of oil per day. Consumption would increase to a much greater extent if supply were not limited. The difference between the estimated consumption and the estimated domestic production would be made up by imports, amounting to the equivalent of 1.2 million barrels of oil per day.

Federal regulation of the wellhead price of natural gas in interstate commerce has encouraged consumption of this premium fuel for nonessential uses and has discouraged its distribution from gas producing States to other States. Recent contract prices for new gas in the intrastate market range from \$1.60 per Mcf to \$2.25, while the highest price ever allowed for long-term interstate gas purchases is \$1.45.

Last year, natural gas in the interstate market sold at wellhead rates that were 25 percent of the Btu equivalent price⁵ of imported crude oil. At that price, natural gas was highly attractive to industry and utilities, and they used the equivalent of about 6 million barrels of oil per day, while new households had to turn to electricity.

Since Federal regulation covers only the interstate market, new onshore gas production has gone primarily to the unregulated intrastate market, where it has received higher prices. From 1973 to 1975, only 19 percent of new reserve additions were committed to the interstate market, and much of that gas was from the Federal domain. The existing distinction between intrastate and interstate sales has given intrastate users first claim on new natural gas.

By 1985, gas from existing reservoirs will be able to satisfy only 55 percent of natural gas demand. It is doubtful that even substantial price increases could do much more than arrest the decline in gas production.

The gap between demand and production in the lower 48 States will have to be filled from new sources, such as Alaskan gas; the Outer Continental Shelf; deeper, tighter onshore formations; the geopressurized zones along the Gulf Coast; synthetic natural gas; and im-

⁵ The Btu equivalent is the price paid for quantities of various energy sources that have the same heat value.

ported liquefied natural gas. In the short term, the new sources of natural gas will not be able to reverse the downward trend in total U.S. production. Supplies for the residential and commercial sector will have to be obtained by diverting gas from electric utilities. However, from the mid-1980's onward, the prospects for gas supply could improve if significant discoveries are made on the Outer Continental Shelf, and if technological advances make possible the exploitation of the deeper, tighter onshore formations, Devonian shale, and geopressurized zones.

IMPLICATIONS FOR THE UNITED STATES

The United States would be profoundly affected by a continuation of current trends of oil and gas demand and supply. To sustain continuation of the rate of growth of demand, the U.S. would be forced to expand domestic production greatly or to increase its already high level of imports, or pursue a combination of both. These courses of action would present serious problems in the short run. But short-term impacts would be eclipsed by even greater problems if U.S. petroleum demand is still growing at the time OPEC production levels off.

Supply disruptions this winter caused short-term unemployment for more than 1 million workers nationally. They have also encouraged firms to consider moving plants, and jobs, to the Sun Belt to assure stable supplies of energy. But these near-term effects are minor compared to the loss of millions of jobs should future energy prices increase dramatically as a result of a continuing upward trend of demand combined with static or declining production.

The United States could face repeated jolts as energy supplies become increasingly unreliable and actual shortages occur more frequently. Regional disruptions could result from unusual weather, failure to bring electricity generating capacity on line, and many other factors. In some cases, the American people could experience mere inconvenience; in others, real suffering, as economic activity ground to a halt. It is difficult to predict which region would encounter problems and when, but future supply disruptions would be very likely.

Some industries, such as the recreation industry, are particularly dependent on a continuing supply of energy. Short-term limitations on energy use are disruptive to these industries. If action is taken now to curb demand, they will continue to flourish. If action is not taken, their very survival may come into question in the future.

A crash program to meet growing demand through increased domestic production would have very serious adverse consequences. Oil, the most critical energy resource, would be drained rapidly, and there-

fore the nation would not have adequate protection against future shortfalls in energy supply. It would be unwise to solve a problem of short-term vulnerability arising from dependence on oil imports by creating a problem of long-term vulnerability arising from depletion of America's resources.

A production effort intended to eliminate oil and gas imports would also harm the environment. The Outer Continental Shelf, Alaska, oil shale, and synthetic fuels would have to be developed as rapidly as possible. Even more coal-fired and nuclear plants would be needed. Major energy production facilities would have to be developed without adequate attention to adverse impacts on public health, society and the environment.

The capital investment required to meet a domestic production level of 48 million barrels of oil equivalent per day by 1985 would exceed \$550 billion, about 37 percent of total U.S. expenditures for all plant and equipment throughout the economy. In recent years, energy production has already been drawing a disproportionate share of capital. From 1973 through 1975, the United States invested \$112 billion in plant and equipment to produce energy, about 35 percent of all such expenditures throughout the economy. Previously, the share of investment going to energy production had ranged between 25 and 30 percent.

Finally, an all-out production effort would raise questions of regional equity and balance. Actual and potential producing States would be pressed to deliver increasing quantities of energy at the expense of their environment and, in some areas, a distinctive way of life. Nonproducing States would be pressed to carry out increasingly drastic conservation programs.

If the United States pursued the course of accepting ever increasing imports, it would face a set of difficult problems. In the past, the United States has enjoyed flexibility in formulating and executing its foreign policy. If, however, the United States continues to increase its dependence on oil imports, its position as a world leader will be weakened. The current vulnerability to supply interruptions affects the whole structure of international relations. Although greater cooperation among the industrialized nations is needed to deal with the energy crisis, the crisis itself raises the specter of future competition among political allies for diminishing oil supplies. Because the United States is the country most wasteful of energy, and because it has been increasing its demand for world oil, the United States has not been able to provide leadership to restrain the growth of world demand.

Reliance on oil imports beyond the short term would also make the U.S. economy even more vulnerable to sudden large oil price increases.

Price vulnerability is as harmful to long-term economic and political interests as supply vulnerability. A precipitous increase in energy prices would place significant inflationary pressures on the economy.

The high level of oil imports has already increased the U.S. merchandise trade deficit from \$2.0 billion in 1971 to \$14.8 billion in 1976. In 1971, oil imports cost \$3.7 billion; in 1976, they cost \$36.4 billion.

The foregoing discussion addressed the most likely developments in U.S. energy demand and supply. The actual situation could be either better or worse. If growth in demand is reduced and significant new discoveries of oil are made, the leveling off and decline of world production would be deferred for a time.

However, one need not engage in fantasy to contemplate a far worse case. Under a set of unfavorable circumstances, U.S. payments for imported oil theoretically could run as high as \$175 billion in 1985. Foreign oil producers might reduce exports to the United States or the world generally for their own economic or political reasons. Some producer nations might choose to conserve their remaining reserves rather than supply world demand. Moreover, a disruption of oil exports from the Persian Gulf would be a disaster for all oil-importing countries, including the United States.

The consequences would be grave if the United States were unable to purchase all the oil it needs. The United States would most likely experience a dramatic interruption of economic activity akin to a depression, and real income would plummet. Rationing and other Government controls would be necessary, leading to an unprecedented Government intrusion into the lives of American citizens.

In developing public policy toward the energy crisis, all three possibilities—the most likely case, the optimistic case, and the pessimistic case—should be considered. It would be foolhardy to base public policy on the most optimistic possibility. Even if the future should prove to be brighter than now appears likely, steps taken to curb demand and increase use of abundant resources would still have been justified to meet the immediate need to reduce vulnerability. In formulating public policy toward energy, the prudent course is to act on the basis of the most likely assumptions about the future, and to bear in mind that the pessimistic set of assumptions is a real possibility.

IMPLICATIONS FOR THE INTERNATIONAL COMMUNITY

Although the United States faces very serious problems, they are far less severe than those faced by most other nations. The 1973-74 embargo and fourfold increase in oil prices have already demonstrated the industrialized countries' vulnerability to arbitrary supply and

price manipulation. The industrialized nations continue to suffer from supply and price vulnerability, large and increasing balance of payment deficits, and resulting constraints on economic growth.

The dramatic 1973-74 OPEC price increases contributed significantly to the worst global recession since the Great Depression. Unemployment, for example, increased 4 percentage points in the U.S. In 1973, the OECD countries and the OPEC countries each had a small surplus in current account balances with the rest of the world, but in 1974 that situation was radically altered. The OECD countries experienced a \$33 billion deficit on current account, while the OPEC surpluses increased to \$70 billion. Since 1973, the oil-importing countries have paid over \$300 billion in oil imports bills to the 13 OPEC countries. Today, each 10 percent price increase adds an additional \$14 billion to the growing OPEC balances.

The massive oil price increases since 1973 have most adversely affected those developing countries that lack domestic oil supplies. Their expenditures for oil rose from about \$4 billion in 1973 to \$12 billion last year. The indirect cost to their economies was even more pronounced. The recession and inflation in the industrialized countries slackened their demand for the developing countries' exports, and raised the prices of the developing countries' imports. From 1973 to 1975 the foreign debt of these developing countries rose from \$67 to \$117 billion.

The developing nations cannot significantly reduce their energy consumption since they are not large energy users. As increasing amounts of scarce foreign exchange are expended for energy imports, other development needs suffer. Many developing countries have reached or even surpassed the limits of their creditworthiness.

The quadrupling of oil prices introduced a massive structural distortion into the international payments mechanism. That distortion has not abated. Debt service amounted to 15 percent of the world's export receipts in 1976. As a result, many countries are finding it more difficult to obtain additional loans from the commercial capital markets. The balances held by OPEC countries have been invested in the industrialized countries, largely in short-term securities, although a shift to longer-term investments is occurring. Most of these funds are invested in the United States and Europe, with only limited amounts flowing to the weaker developed and developing countries. Ironically, it is these very countries that suffer most from the energy crisis and have the greatest need for a compensating flow of capital.

The oil-exporting countries and the oil-importing countries share a number of long-term interests. Both need a growing global economy and a liberal trading system to ensure the availability of future markets for their products. All nations, including the oil exporters, will

someday have to meet their energy needs from resources other than oil and gas. Hence, all nations are part of the coming energy transition, even though they will be affected very differently.

* * *

The prognosis for the United States and the world is serious if current growth in demand for oil continues. In the short term, American vulnerability to a supply interruption would increase. By the mid-1980's, the United States could be vying for scarce oil against its allies and other consuming nations, including the Soviet Union. Then, prices could increase dramatically as a result of tremendous pressure on world oil supply.

During the last years of the 20th century, the United States will have to reduce significantly its reliance on oil, and make greater use of abundant energy sources. For the long term, the United States and other nations will need to develop renewable and essentially inexhaustible sources of energy. If steps are not taken now to prepare for this transition, the United States and the world will face serious economic and political problems.

Chapter III.—Principles and Strategy of the National Energy Plan

Broad public understanding of the gravity of the energy problem, a commitment to action, and a willingness to endure some sacrifice are all indispensable to the success of a national energy plan. In the present circumstances, an energy plan that demanded nothing from the American people would be no energy plan at all, but merely a prescription for chaos at a later date.

Changes in energy demand and supply have long leadtimes, and, therefore, the coming energy transition cannot be made overnight. For the transition to be made without serious economic and social disruptions, it will have to take place over a period of years. If the United States is to be prepared for the time when world oil production approaches its capacity limitation and then begins to level off, it must take action now.

The ultimate question is whether this society is willing to exercise the internal discipline to select and pursue a coherent set of policies well in advance of a threatened disaster. Western democracies have demonstrated such discipline in the past in reacting to immediate, palpable threats to survival, as in time of war. But they have had less success in harnessing their human and material resources to deal with less visible and immediate threats to their political and economic systems. When dangers appear incrementally and the day of reckoning seems far in the future, democratic political leaders have been reluctant to take decisive and perhaps unpopular action. But such action will be required to meet the energy crisis. If the nation continues to drift, it will do so in an increasingly perilous sea.

PRINCIPLES

The principles set forth in this chapter provide a framework not only for present policies, but also for development of future policies. Planning is necessarily an ongoing process. The National Energy Plan will have to be adjusted continually as new experience and knowledge are gained, as government programs take effect, as new technologies develop, and as the world's political and economic circumstances change.

The following 10 principles divide into two groups. The first five establish the context in which energy policy must be formulated. The

remaining five are fundamental to the proposed comprehensive National Energy Plan.

The first principle is that the energy problem can be effectively addressed only by a Government that accepts responsibility for dealing with it comprehensively, and by a public that understands its seriousness and is ready to make necessary sacrifices. The declining availability of oil and natural gas will affect virtually all energy prices and consumption patterns in the United States, for the various energy supplies are all part of an integrated energy market. Therefore, in this democratic society, a solution can be found only in comprehensive Government policy-making informed by public comment and supported by public understanding and action.

The Federal Government can pass laws and encourage action. State and local governments can play active roles. But this society can function at its best only when citizens voluntarily work together toward a commonly accepted goal. Washington can and must lead, but the nation's real energy policy will be made in every city, town and village in the country.

The second principle is that healthy economic growth must continue. It is an axiom of public policy that full employment be promoted. The energy problem can be solved without turning off or slowing down America's economic progress. In developing energy policy, measures should be designed to minimize adverse economic and fiscal consequences by returning to the economy funds collected to carry out energy policy. National energy policy can move toward economic rationality while protecting jobs, avoiding rampant inflation, and maintaining economic growth. Conservation initiatives, for example, not only contribute to productivity, but also create a large number of new jobs. Indeed, in the long run, the nation can continue to enjoy economic health only if it solves its energy problems.

The third principle is that national policies for the protection of the environment must be maintained. Energy policy should sustain and improve the quality of life of the American people. It would be ironic if, in moving toward that objective, the nation unnecessarily degraded the quality of the environment and made this country and the planet a less healthful place in which to live.

Virtually every available source of energy has its disadvantages. Storage and combustion of hydrocarbons can pollute the air. Oil imports and drilling on the Outer Continental Shelf present a risk of spills. Strip mining of coal scars the landscape, and deep mining causes deaths through accidents and black lung disease; coal combustion also presents risks to health; liquefied natural gas poses safety problems, as do light-water nuclear reactors. In energy planning, it is necessary to recognize hazards and risks and to reduce them to relatively low levels.

In the long run, there is no insurmountable conflict between the twin objectives of meeting energy needs and protecting the quality of the environment. The energy crisis and environmental pollution both arose from wasteful use of resources and economic and social policies based on the assumption of unlimited and cheap resources. The solutions to many energy and environmental problems follow a parallel course of improving efficiency and harnessing waste for productive purposes.

The fourth principle is that the United States must reduce its vulnerability to potentially devastating supply interruptions. Although conserving energy in general is an important goal, conserving oil has an even higher priority. Continued high vulnerability to interruptions of foreign oil supply is unacceptable.

Considerations of national security, as well as the problem of funding ever-increasing balance of payments deficits, suggest rejection of any "solution" to the energy problem through unrestrained growth of oil imports. Continued growth of imports would erode the nation's economic security, promote dissension with allies, and jeopardize America's world leadership. Moreover, the time is approaching when world oil production will no longer be able to supply the United States with increasing levels of imports.

The solution to the problem of vulnerability does not lie in a crash program of production to achieve energy independence. There is no justification for massive, reckless development of all U.S. energy resources, depletion of critical domestic oil and gas reserves, pollution of the environment, draconian conservation measures, and rejection of the substantial economic benefits of oil imports, all in the name of energy independence.

An appropriate and far more sensible goal is relative invulnerability. The United States should be prepared to import foreign oil for a number of years because it is an available source of supply that does not deplete domestic resources. Through effective conservation and increased use of abundant domestic resources such as coal, oil imports can be reduced to a manageable level. A large Strategic Petroleum Reserve, diversification of foreign sources of oil, and contingency plans should help to deter interruptions of foreign oil supply and protect the economy should an interruption occur.

The fifth principle is that the United States must solve its energy problems in a manner that is equitable to all regions, sectors, and income groups. No segment of the population should bear an unfair share of the total burden, and none should reap undue benefits from the nation's energy problems. In particular, the elderly, the poor, and those on fixed incomes should be protected from disproportionately adverse effects on their income. Energy is as necessary to life as food and shelter.

The energy industries need adequate incentives to develop new resources and are entitled to sufficient profits to encourage exploration and development of new finds. But they should not be allowed to reap large windfall profits as a result of circumstances not associated with either the marketplace or their risk-taking. The fourfold increase in world oil prices in 1973-74 and the policies of the oil-exporting countries should not be permitted to create unjustified profits for domestic producers at consumers' expense. By raising the world price of oil, the oil-exporting countries have increased the value of American oil in existing wells. National energy policy should capture that increase in value for the American people. However, where incentives are legitimately needed to stimulate new production, energy policy should allow adequate returns to producers. The distribution of the proceeds of higher prices among domestic producers and consumers must be equitable and economically efficient if the nation is to spread the costs fairly across the population and meet its energy goals.

Some regions of the country, particularly the Gulf Coast States and Appalachia, are large energy producers. Other regions, such as the Rocky Mountain and Great Plains States, have large energy resources which have not yet been extensively developed. And still other regions, such as New England and California, import most of their energy from other regions and other nations. The Plan must assure that policies are equitable across the country, and that the special needs of each region are met. Prices for energy should be reasonably uniform to prevent economic dislocations and unjustified variations in consumer costs.

The environmental quality of producing States and States with untapped resources should be protected by strict standards effectively enforced. Producing States should be fairly compensated, and consuming States should be assured a fair share of energy supplies at reasonable prices.

The Federal Government can enact national policies to further these goals, and can recognize that the States also have important responsibilities for the formulation and execution of energy policy. But States within the various regions must also accept their share of the responsibility for national equity if the U.S. is to avoid "energy Balkanization." It would be desirable for States to develop energy policies that complement the Plan while meeting local and regional needs.

The sixth principle, and the cornerstone of National Energy Policy, is that the growth of energy demand must be restrained through conservation and improved energy efficiency. Conservation and improvement in energy efficiency is the most practical course of action for the United States and for the nations of the world. Conservation is cheaper than production of new energy supplies, and is the most effective means for protection of the environment.

Conservation and improved efficiency can lead to quick results. A significant percentage of poorly insulated homes in the United States could be brought up to strict fuel efficiency standards in less time than it now takes to design, license, and build one nuclear powerplant.

Although conservation measures are inexpensive and clean compared with energy production, they do involve sacrifice and are sometimes difficult to implement. If automobiles are to be made lighter and less powerful, the American people must accept some sacrifice in comfort and horsepower. If industry is required to make energy-saving investments and to pay taxes on the use of scarce fuels, there will be some increases in the cost of consumer products. These sacrifices, however, need not result in major changes in the American way of life or in a reduced standard of living. Automobile fuel efficiency can be greatly improved through better design of cars, and thus gasoline consumption could be significantly reduced without inhibiting Americans' ability to travel. With improved energy efficiency, the impact of rising energy prices can be significantly moderated. Energy conservation, properly implemented, is fully compatible with economic growth, the development of new industries, and the creation of new jobs for American workers. Energy consumption need not be reduced in absolute terms; what is necessary is a slowing down in its rate of growth.

If a conservation program is instituted now, it can be carried out in a rational and orderly manner over a period of several years. It can be moderate in scope, and can apply primarily to capital goods, such as homes, automobiles, factories, equipment, and appliances. If, however, conservation is delayed until world oil production approaches its capacity limitation, it will have to be carried out hastily under emergency conditions. It will then be drastic; and, because there will not be time to wait for incremental changes in capital stock, conservation measures will have to cut much more deeply into patterns of behavior, disrupt the flow of goods and services, and reduce standards of living.

Finally, conservation in America can contribute to international stability by moderating the growing pressure on world oil resources. Indeed, reduction of America's demand for world oil would be a form of assistance to the developing countries.

The seventh principle underlying the National Energy Plan is that energy prices should generally reflect the true replacement cost of energy. Energy prices should move toward a level that reflects the true value of energy in order for market signals to work in harmony with conservation policy. When the cost of expensive foreign oil is averaged with cheaper domestic oil, consumers overuse oil. Government policy that promotes overuse by artificially holding down prices

misleads consumers into believing that they can continue to obtain additional quantities of oil at less than its replacement cost.

Artificially low prices for particular energy sources also distort interfuel competition. The artificially low price of natural gas, for example, has encouraged its use by industry and electric utilities, which could use coal, and has made gas unavailable for new households, which could make better use of its premium qualities.

Neither Government policy nor market incentives can create additional oil or gas in the ground. But from a long-term perspective, prices are an important influence on production and use. As long as energy consumers are enticed into believing that they can continue to pay yesterday's prices for tomorrow's energy, they will continue to use more energy than the nation can really afford, U.S. resources will be rapidly exhausted, and continued overuse will make the inevitable transition more sudden and difficult.

Although producers need incentives for exploration and new development, pricing policies should not give them windfall profits unrelated to their economic contribution. If producers were to receive tomorrow's prices for yesterday's discoveries, there would be an inequitable transfer of income from the American people to the oil and gas producers, and producers' profits would be excessive.

The eighth principle is that both energy producers and consumers are entitled to reasonable certainty as to Government policy. An inadequately organized Federal Government, conflicting signals from different Federal agencies, and unwieldy and confusing regulatory procedures have resulted in major bottlenecks in the development of energy resources. The Plan should resolve a wide range of uncertainties that have impeded the orderly development of energy policy and projects. Some uncertainties are inherent in a market economy, and Government cannot and should not shelter industry from the normal risks of doing business. But Government can and should provide business and the public with a clear and consistent statement of its own policies, rules, and intentions, so that intelligent private investment decisions can be made. In order to be able to provide certainty and consistency in energy policy-making, the Federal energy agencies should be organized into a Department of Energy.

The ninth principle is that resources in plentiful supply must be used more widely, and the nation must begin the process of moderating its use of those in short supply. Although coal comprises 90 percent of domestic fossil fuel reserves, the United States meets only 18 percent of its energy needs from coal. Seventy-five percent of energy needs are met by oil and natural gas although they account for less than 8 percent of U.S. reserves. This imbalance between reserves and consumption should be corrected by shifting from oil and gas to coal and other domestic energy sources.

If the United States is to preserve its scarce reserves of oil and gas and still reduce the growth of imports, policies must be forged to reduce consumption of oil and gas, particularly by automobiles, industry, and electric utilities. As industry reduces its use of oil and gas, it will have to turn to coal and other fuels. The choices for electric utilities for the foreseeable future will be coal and nuclear power.

Expanding future use of coal will depend in large part on the introduction of new technologies that permit it to be burned in an environmentally acceptable manner, in both power plants and factories, for electricity, for process steam, and for heat. Efforts must also be made to perfect processes for low Btu gasification of coal and to develop new technologies for advanced high Btu gasification.

Light-water nuclear reactors, subject to strict regulation, can assist in meeting the nation's total net energy deficit. The 63 nuclear plants operating today provide approximately 10 percent of U.S. electricity, about 3 percent of total energy consumed. That contribution could be significantly increased. The currently projected growth rate of nuclear energy is substantially below prior expectations due mainly to the recent drop in demand for electricity, labor problems, equipment delays, health and safety problems, lack of a publicly accepted waste disposal program, and concern over nuclear proliferation. The Government should ensure that risks from nuclear power are kept as low as possible, and should also resolve problems and unnecessary delays in the nuclear licensing process.

To the extent that electricity from coal is substituted for oil and gas, the total amounts of energy used in the country will be somewhat larger due to the inherent inefficiency of electricity generation and distribution. But conserving scarce oil and natural gas is more important than saving coal.

The tenth principle is that the use of nonconventional sources of energy must be vigorously expanded. Relatively clean and inexhaustible sources of energy are a hopeful prospect, as supplements to conventional energy resources in this century, and as major sources of energy in the next. Many of these sources permit decentralized production, and thus provide alternatives to large, central systems. Traditional forecasts of energy use assume that nonconventional resources, such as solar and geothermal energy, will play only a minor role in the energy future. Unless positive and creative actions are taken by Government and the private sector, these forecasts will become self-fulfilling prophecies. Other technologies that increase efficiency of energy use, such as cogeneration of industrial process steam and electricity, should also be encouraged.

The Plan should not be premised on technological miracles. But nonconventional technologies are not mere curiosities. Steady technological progress is likely, breakthroughs are possible, and the

estimated potential of nonconventional energy sources can be expected to improve. Many nonconventional technologies are already being used, and with encouragement their use will grow. Because nonconventional energy sources have great promise, the Government should take all reasonable steps to foster and develop them.

THE BROAD PERSPECTIVE

The U.S. has three overriding energy objectives. As an immediate objective, which will become even more important in the future, the U.S. must reduce its dependence on foreign oil to limit its vulnerability to supply interruptions. In the medium term, the U.S. must weather the stringency in world oil supply that will be caused by limitations on productive capacities. In the long term, the U.S. must have renewable and essentially inexhaustible sources of energy for sustained economic growth. The strategy of the Plan contains three major components to achieve these objectives.

First, by carrying out an effective conservation program in all sectors of energy use, through reform of utility rate structures, and by making energy prices reflect true replacement costs, the nation should reduce the annual rate of growth of demand to less than 2 percent. That reduction would help achieve both the immediate and the medium-term goals. It would reduce vulnerability and prepare the nation's stock of capital goods for the time when world oil production will approach capacity limitations.

Second, industries and utilities using oil and natural gas should convert to coal and other abundant fuels. Substitution of other fuels for oil and gas would reduce imports and make gas more widely available for household use. An effective conversion program would thus contribute to meeting both the immediate and the medium-term goals.

Third, the nation should pursue a vigorous research and development program to provide renewable and other resources to meet U.S. energy needs in the next century. The Federal Government should support a variety of energy alternatives in their early stages, and continue support through the development and demonstration stage for technologies that are technically, economically, and environmentally most promising.

The Plan seeks to achieve the overriding objectives by other means as well. To reduce vulnerability, the Strategic Petroleum Reserve should be expanded, foreign sources of oil should be diversified, and contingency plans should be put in place. To help weather the approaching capacity limitations on world oil production, incentives should be provided to encourage new production in Alaska, on the Outer Continental Shelf, and from advanced recovery techniques. Potential new sources of gas hold great promise and should be developed.

Conversion from oil and gas to coal should be facilitated by development of more environmentally acceptable methods for using coal.

The 10 principles of the National Energy Plan provide a realistic framework for these actions. By pursuing conservation, bringing energy prices into line with replacement costs, and expanding the use of coal, the U.S. can reduce oil imports to an acceptable level and prepare for the coming stringency in oil supplies. Backed by a large Strategic Petroleum Reserve, a more diversified set of foreign oil suppliers, and contingency plans, the United States can reduce its vulnerability to supply interruptions to an acceptable level. Measures can be designed to assure that American workers, the poor, and the elderly do not suffer as a result of rising prices. Economic growth can be promoted and inflationary pressures kept within bounds. Regional and environmental imbalances can be recognized and corrected with maximum equity. And nonconventional sources of energy can be promoted to meet long-term needs.

The United States is at a turning point. It can choose, through piecemeal programs and policies, to continue the current state of drift. That course would require no hard decisions, no immediate sacrifices, and no adjustment to the new energy realities. That course may, for the moment, seem attractive. But, with each passing day, the nation falls farther behind in solving its energy problems. Consequently, its economic and foreign policy position weakens, its options dwindle, and the ultimate transition to stringency in oil supplies and higher oil prices becomes more difficult.

An alternative to continued drift is the comprehensive National Energy Plan, set forth in the next five chapters. Chapter IV describes the Plan's conservation and fuel efficiency program. Chapter V contains proposals for the pricing of oil and natural gas and for resolving other issues affecting those resources. Chapter VI presents the Plan's program for conversion to coal and other fuels, and its programs for nuclear and hydroelectric power. Chapter VII presents initiatives for the development of nonconventional resources and sets forth the Administration's policy toward energy research and development. Chapter VIII addresses the role of government and the public in formulating and carrying out energy policy. It discusses, in particular, the establishment of national energy goals, the creation of the Department of Energy, the development of a national energy information system, competition within the energy industries, the role of the States, assistance to people with low incomes, and public participation. Finally, Chapter IX discusses the impacts of the Plan.

CHAPTER IV—THE NATIONAL ENERGY PLAN: CONSERVATION AND ENERGY EFFICIENCY

The cornerstone of the National Energy Plan is conservation, the cleanest and cheapest source of new energy supply. Wasted energy—in cars, homes, commercial buildings and factories—is greater than the total amount of oil imports. By reducing the need for additional oil imports, conservation and improved efficiency in the use of energy can contribute to national security and international stability. By reducing the need for additional domestic energy production, conservation can contribute to environmental protection and to an adequate supply of capital for balanced economic growth.

America needs to embrace the conservation ethic. The attitudes and habits developed during the era of abundant, cheap energy are no longer appropriate in an era of declining supplies of America's predominant energy sources. Conservation offers vast opportunities for American creativity and know-how. The challenge of saving energy should galvanize the ingenuity and talents of the American people. As individual Americans find new ways to save energy in their daily lives, they will reduce their own energy bills and contribute to the future well-being of the country.

In buying durable goods, in deciding how to travel to work or how to spend leisure time, and in making countless other decisions, Americans will have to be conscious of the rising price of energy, and will have to emulate the shrewdness and practicality of earlier generations. For example, when buying a home, a car, or an appliance, consumers ought to consider not only an item's initial cost, but also its annual operating cost—including its energy consumption. In many cases, an item that is initially more expensive will actually prove to be cheaper over a period of years.

If vigorous conservation measures are not undertaken and present trends continue, energy demand is projected to increase by more than 30 percent between now and 1985. Americans can eliminate energy waste through effective conservation and improved energy efficiency in transportation, buildings, and industry.

TRANSPORTATION

Transportation consumes 26 percent of U.S. energy, and about half of that is used by automobiles. About 5 million barrels of oil per day

are consumed by automobiles. Domestically manufactured automobiles use considerably more gasoline than imported cars. (See Figure IV-1.) More efficient, lighter, and less powerful cars would save a substantial amount of gasoline. Carpooling could also save significant quantities of gasoline. If 4 commuting cars out of 10 carried 1 additional passenger, 2.5 percent of total oil consumption, about 400,000 barrels per day, could be saved. No serious energy policy can ignore these opportunities for large savings.

Overseas, there is no greater symbol of American energy waste than the heavy, powerful, accessory-laden American automobile. An average new car in Europe weighs about 1,900 pounds; in the United States, about 3,300. From the perspective of energy efficiency, a major problem with American cars is their weight and power, not necessarily their interior size. With better design and other improvements, family size cars could be considerably more fuel efficient.

In late 1975, the Congress enacted legislation requiring that the average mileage of new cars be 20 miles per gallon by 1980, and 27.5 miles per gallon by 1985, compared to 14 miles per gallon actually achieved in 1974. However, many consumers still appear to prefer heavier cars with high acceleration and low fuel efficiency. It is questionable whether the penalties for noncompliance by manufacturers are strong enough to assure that the current statutory standards will be met. The present legislation is, therefore, insufficient to ensure the kind of reductions that are needed in the transportation sector. Reduction in gasoline consumption is necessary. Accordingly, the Plan proposes a national goal to reduce gasoline consumption 10 percent by 1985.

To help achieve that goal, a graduated excise tax would be imposed on new automobiles with fuel efficiency below the fleet average levels required under current legislation. Graduated rebates would be given for new cars with mileage better than the standard. The tax schedule would be fixed by statute, and taxes would rise from 1978 to 1985 and remain constant thereafter. The rebate schedule would be set by the Internal Revenue Service so that total estimated rebate payments would be equal to estimated tax receipts, with no gain or loss to the Treasury. The rebate schedule would be fixed in advance so that manufacturers and consumers would know the exact amount of tax or rebate for every car. Rebates would be available for cars purchased after May 1, 1977. These rebates would be paid from taxes collected on 1978 fuel inefficient vehicles.

Examples for the model year 1985 illustrate the operation of the tax-rebate system. In that year the statutory standard will be 27.5 miles per gallon. A car with at least 20.5 miles per gallon but less than 21.5 would bear a tax of \$610; and a car with less than 12.5 miles per

Fuel Economy For New Automobiles

Source: Environmental Protection Agency and Federal Energy Administration.

Figure IV-1

gallon would bear a tax of \$2,488, the maximum under the proposed system. In the same year, a car with 30.5 miles per gallon would earn a rebate of \$176; a car with 34.5 miles per gallon would earn a rebate of \$362; and a car with 38.5 miles per gallon or above would earn a rebate of \$493. The statutory maximum would be \$500. Actual rebates might differ from these estimates, depending on the estimate that will be made in 1984 of the composition of new car sales during the 1985 model year, and the tax receipts that would result from that composition.

Cars manufactured in the United States or Canada would be eligible for rebates; for cars manufactured in other countries, rebates would be provided only after agreements were reached with individual countries. The President's Special Representative for Trade Negotiations will work with other nations to develop equitable rebate agreements.

Electric vehicles would be eligible for the maximum rebate. These vehicles consume no gasoline and are a clean method of transportation for intra-urban use. Electric delivery trucks have long been used in Europe.

The Administration intends to continue the progress that has been made to date on automobile fuel efficiency. The Secretary of Transportation will begin the analytic work necessary to examine how his authority should be used to raise mileage standards above 27.5 miles per gallon beyond 1985.

The tax on fuel inefficient new cars will not reach old cars, and it will not directly influence the number of miles driven. A further measure is necessary to help meet the goal of a 10 percent reduction in gasoline consumption by 1985. Accordingly, a program is proposed to establish annual targets for gasoline consumption, backed by a standby tax on gasoline.

A gasoline tax is a highly effective measure for conservation because it affects all cars and all drivers. However, in order to provide maximum scope for citizen action, the tax would not be imposed as long as Americans achieved specified annual gasoline consumption targets. The proposal would challenge the American people to reduce gasoline consumption through use of more efficient cars, increased use of car pools and van pools, compliance with the 55-miles-per-hour speed limit, more efficient driving, regular maintenance, and reduced use of cars. If the American people join together to meet this challenge, the standby tax will never take effect.

The targets established in the standby tax program would permit limited annual increases in gasoline consumption from 7.35 million barrels per day in 1978 to 7.45 million in 1980. From 1980 to 1987, when fuel-efficient cars will become a sizable share of the total automobile fleet, the program would require annual reductions in gasoline consumption. The target in 1985 would be 6.60 million barrels per day.

Under the program, no tax could go into effect until 1979. In 1979 or any subsequent year, the tax would go into effect if gasoline consumption in the preceding year exceeded the target by at least 1 percent. The amount of the tax would equal 5 cents for each percent that gasoline consumption exceeded the target in the preceding year. The tax could be reduced by 5 cents a year based on the formula in the legislation. The tax could not increase or decrease more than 5 cents per year and it could never exceed 50 cents.¹

Funds collected from the standby gasoline tax would be rebated progressively to the public. For each five cents of tax imposed, nearly \$6 billion in revenue would be generated. These revenues would be rebated on a per capita basis in the amount of \$25 to each person per year or a payment of \$100 for a family of four. If a tax of twenty-five cents were to be imposed, each citizen would be eligible for a payment of \$125, or \$500 for a family of four.

Passenger automobiles are not the only wasteful vehicles. Under the Energy Policy and Conservation Act, the Secretary of Transportation plans to promulgate by next July efficiency standards for light-duty trucks weighing 6,000 pounds or less. Once those standards are in effect, these vehicles will become subject to a tax-rebate system similar to that for automobiles. The President has directed the Secretary to commence a proceeding to cover trucks weighing over 6,000 pounds.

Legislation is requested to remove the 10 percent excise tax on inter-city buses. Buses, like railroads, are fuel-efficient forms of transportation that deserve encouragement.

The existing Federal gasoline tax on aviation fuel would be raised to 11 cents per gallon except for use by commercial airlines and in farming. The current rebate of half of the Federal excise tax on fuel used by motorboats would be eliminated. Revenues from the elimination of that rebate would go to the Land and Water Conservation Fund.

The Federal Government itself must set an example in reducing gasoline consumption. The President is issuing an Executive Order requiring that the Federal fleet of new cars meet an average mileage standard that will rise from 2 miles per gallon above the average fuel economy standard applicable in 1978 to 4 miles per gallon above in

¹ The tax would increase if an annual target is exceeded and would decrease if an annual target is met. For example, if standby tax legislation is enacted in 1977, the first target would be for 1978. If the target is exceeded by 0.5 percent in 1978, no tax would go into effect for 1979, because the tax is triggered only by an excess of at least 1 percent. If the 1979 target is exceeded by 10 percent, a 5-cents-per-gallon tax would go into effect for 1980; regardless of the amount of excess, no increase in the tax can be more than 5 cents for any year. If the 1980 target is exceeded by 1 percent, the 5-cents-per-gallon tax would remain in effect without any increase because the tax can reach 10 cents per gallon only if the excess in the previous year was at least 2 percent. If the 1981 target is exceeded by 2 percent, the tax would increase to 10 cents per gallon for 1982. If in 1982 consumption is 25 percent below the target, the tax for 1983 would decrease from 10 cents per gallon to 5 cents per gallon. No decrease in the tax can be more than 5 cents per gallon for any year.

1980 and thereafter. This initiative not only will save gasoline, but also will provide incentives for the development of more fuel-efficient vehicles.

The Federal Government will also initiate a major van pooling demonstration program in areas not served by mass transit. About 6,000 vans will be purchased by the Federal Government and made available to Federal employees. All costs of the program will be repaid to the Federal Government by the riders.

If it should appear that the goal of a 10 percent reduction in gasoline consumption by 1985 is not being achieved, additional measures, including a tax on commuter parking and minimum automobile mileage standards, would have to be considered.

Beyond this Federal program, States and localities can promote gasoline conservation through local initiatives. Observance of the national 55-miles-per-hour speed limit should be vigorously enforced by States and municipalities. The Secretary of Transportation has authority to withhold Highway Trust Fund revenues from States not enforcing the 55-miles-per-hour speed limit. If the widespread noncompliance and lack of enforcement continue, the Secretary may find it necessary to exercise that authority.

Inspection and maintenance programs to determine compliance with the Clean Air Act can also provide gasoline savings. In areas where air quality indicates a need for inspection and maintenance, gasoline savings of 2 percent can be achieved.

Reduction in gasoline consumption will entail a loss of revenues to the States from their taxes on gasoline, which are used to operate and maintain highways. A way needs to be found to ease this additional burden on State treasuries. The Administration will develop a program to compensate them for this loss through sources such as the Highway Trust Fund.

In the long run, mass transit by bus and rail must play a significant role in reducing energy consumption in the transportation sector. Reliable, inexpensive mass transit is needed to serve existing, spread out metropolitan areas. New development patterns based on public transportation can bring homes and offices, churches and schools, shops and other community buildings together, and at the same time conserve energy. The nation must begin to explore a system of incentives for more efficient transportation just as it is creating disincentives for inefficient transportation.

BUILDINGS

Currently, there are approximately 74 million residential units in the United States, and 1.5 million nonresidential buildings with some 29 billion square feet of floor space. Almost 20 percent of U.S. energy

is used to heat and cool buildings. Some of these buildings needlessly waste as much as half of that energy. The hermetically-sealed glass and steel skyscraper is the analogue of the gas-guzzling automobile. The energy inefficiency of American buildings is a direct result of the cheap energy era in which most of these structures were built.

The potential savings from improving the energy efficiency of the nation's stock of buildings are enormous. Installation of ceiling and roof insulation, weatherstripping of doors and windows, caulking of cracks, installation of clock thermostats, and simple furnace modifications could result in substantial energy savings.

The Plan includes a national program designed to bring 90 percent of all residences and many public and other buildings up to minimum Federal standards by 1985. The program contains the following elements:

First, homeowners would be entitled to a tax credit of 25 percent of the first \$800 and 15 percent of the next \$1,400 spent on approved conservation measures. The credits would be available for measures undertaken between April 20, 1977, and December 31, 1984. A list of eligible measures will be included in proposed legislation.

Second, State public utility commissions would be required to direct their regulated utilities to offer their residential customers a "turnkey" conservation service, financed by loans repaid through monthly bills. Utilities would also inform customers of other available conservation programs, and advise them how to obtain financing, materials, and labor to carry out conservation measures themselves. Other fuel suppliers will be encouraged to offer similar programs, with the help of State energy offices.

Third, the Federal Government will remove the barriers to opening a secondary market for residential energy conservation loans through the Federal Home Loan Mortgage Corporation and the Federal National Mortgage Association. This action should help to ensure that capital is available to homeowners at reasonable interest rates for residential energy conservation through private lending institutions.

Fourth, increased funds would be available to aid people with low incomes to weatherize their homes. Under this proposal, \$130 million would be provided in fiscal 1978, \$200 million in 1979, and \$200 million in fiscal year 1980. The Secretary of Labor has been directed to take all appropriate steps to ensure that recipients of funds under the Comprehensive Employment Training Act (CETA) will supply labor for the weatherization effort. The CETA program's employment levels, as proposed by the Administration, would meet the labor requirements of the low-income weatherization program.

Fifth, the Department of Agriculture has begun a rural home conservation program in cooperation with rural electric cooperatives with loans provided through the Farmers Home Administration.

Sixth, businesses would be entitled to a 10 percent tax credit for investments in approved conservation measures, in addition to the existing investment tax credits. A list of approved measures would be included in the legislation. The credit would be available to owners of apartment buildings, and tenants should benefit from the impact of reduced energy costs on rents.

Seventh, a Federal grant program would assist public and non-profit institutions such as schools and hospitals in conservation. The program would be funded at the rate of \$300 million per year for 3 years.

Eighth, the Local Public Works Program, under which the Federal Government provides funds for public works projects for State and local government units, will include repair of State and local government buildings. The Department of Commerce, which administers the program, will strongly encourage State and local governments to include in their proposals actions that will contribute to energy conservation.

Except for participation by electric and gas utilities, the proposed national program is a voluntary one. It does not initially include any intervention by the Federal Government into the homes of individual Americans. The American people already have ample incentives for improving the energy efficiency of their homes. Home heating and cooling bills have risen dramatically in recent years, and the prices for all fuels used in home heating and cooling will rise even more in the future. The program provides the means for carrying out conservation measures: tax credits, federally encouraged loans, and the assistance of utilities. If, however, the present reliance on voluntary measures is insufficient to achieve widespread residential energy conservation, then mandatory measures will be considered, such as a requirement that homes be insulated before they are sold.

New buildings should also be energy efficient. The President is directing the Department of Housing and Urban Development to advance by 1 year, from 1981 to 1980, the effective date of the mandatory standards required by the Energy Policy and Conservation Act. Funds will be made available to States to help them in this effort.

The President is issuing an Executive Order to upgrade the efficiency of Federal buildings. He is directing all Federal agencies to adopt procedures which aim at reducing energy use per square foot by 1985 by 20 percent from 1975 energy consumption levels for existing Federal buildings and by 45 percent for new Federal buildings. Investments which are not cost-effective would not be funded under the program. The Director of the Office of Management and Budget and the Administrator of the Federal Energy Administration will implement this program.

Finally, the Administration will request appropriations of up to \$100 million over the next 3 years to add solar hot water and space heating to suitable Federal buildings to reduce consumption of conventional fuels and demonstrate the feasibility of widespread solar energy use.

APPLIANCES

Major home appliances such as furnaces, air-conditioners, water heaters, and refrigerators account for 20 percent of the nation's energy consumption.² Most of these appliances could achieve significant reductions in energy use with relatively small increases in cost. Current legislation relies mainly on voluntary efforts to meet industry-wide average targets, and permits the establishment of mandatory standards only after long delays. New legislation is proposed to streamline the regulatory process. The present voluntary program will be replaced by mandatory minimum standards on certain major home appliances as soon as possible. The National Bureau of Standards will continue to develop procedures to test the energy efficiency of appliances. The Federal Energy Administration will continue to promulgate test procedures. The Federal Trade Commission will establish labeling requirements.

FUEL EFFICIENCY IN INDUSTRY

Industry accounts for 37 percent of the nation's energy consumption. Since the 1973-74 oil supply interruption, industry has done better than other sectors in conserving energy, but still has a large potential for further savings. For example, various U.S. industries are substantially less fuel efficient than their West German counterparts. (See Figure IV-2.) Industrial firms have an incentive to make energy-saving investments that are cost-effective from their own perspective. The price industry pays for much of the energy it consumes is not the marginal cost of energy, but rather a "rolled in" average cost, and often industrial firms receive volume discounts. In many cases, energy costs are small relative to the first costs of energy-saving investments. Therefore, energy-saving investments frequently have a lower value to industry than to society.

The oil and gas pricing program, described in Chapter V, and the taxes on industrial and utility use of oil and gas, described in Chapter VI, would provide substantial improvement in overall industrial energy efficiency.

To achieve greater savings within the industrial sector, an additional 10 percent investment tax credit would generally be available

² This figure includes the heating and cooling of buildings.

U.S. Industry Energy Efficiency Compared to West Germany, for Major Energy-Intensive Industries

Source: Comparison of Energy Consumption Between W. Germany & the U.S., Stanford Research Inst., June 1975.

Figure IV-2

for investments in energy-saving equipment, including solar energy systems. A list of types of eligible investments would be included in the legislation. The Secretary of the Treasury would have authority to add items to the list and to delete items that do not effectively conserve energy after consultation with the Administrator of the Federal Energy Administration.

COGENERATION AND DISTRICT HEATING

About three-quarters of the energy used by industry actually performs useful work; the rest is waste heat. In addition, two-thirds of the energy used in electricity generation and distribution is wasted. In 1975, waste heat from these sources was equivalent to over 7 million barrels of oil per day.

One way to use this waste heat is through cogeneration, the simultaneous production of process steam and electricity. Cogeneration provided 15 percent of U.S. energy as recently as 1950, but now contributes only 4 percent.

Although cogeneration is economical today and will become increasingly attractive as energy prices rise, a variety of institutional barriers impede its development. A program is proposed to remove these barriers by assuring that industrial firms generating electricity receive fair rates from utilities for both the surplus power they would sell and for the backup power they would buy. Industries using cogeneration to produce electricity could be exempted from State and Federal public utility regulation, and would be entitled to use public utility transmission facilities to sell surplus power and buy backup power. An additional tax credit of 10 percent above the existing investment tax credit would be provided for industrial and utility cogeneration equipment. Finally, industrial firms and utilities which invest in cogeneration equipment could be exempted from the requirement to convert from oil and gas in cases where an exemption is necessary for cogeneration. Cogeneration would reduce the capital requirements of electric utilities.

Another productive use of waste heat which should be fully explored is district heating. State public utility commissions should give close attention to this option in their processing of applications for new utility generating capacity.

The Government proposes to demonstrate a commitment to district heating by funding in fiscal 1978 a program to make use of the large quantities of waste heat generated by facilities of the Energy Research and Development Administration. ERDA would recover the waste heat for use on site and would also pipe steam and hot water to nearby households, industry, and agriculture. After a study of the feasibility of this concept, actual implementation of the program could occur at ERDA's facilities at Oak Ridge, Tennessee; Paducah, Kentucky; Portsmouth, Ohio; and Savannah River, South Carolina.

The Plan seeks to achieve the large savings available from productive use of waste heat through positive incentives. Careful review will be made of progress in the use of waste heat. If industry and utilities do not respond adequately, consideration will be given to a tax on waste heat or other direct measures to reduce this loss of energy.

UTILITY REFORM

Conventional utility pricing policies discourage conservation. The smallest users commonly pay the highest unit price due to practices such as declining block rates. Rates often do not reflect the costs imposed on society by the actions of utility consumers. The result is waste and inequity.

Electrical energy is difficult and expensive to store, so a utility's need for plant and equipment is determined by its peak demand. If electricity consumption during peak periods were reduced, fewer costly new additions to utility capacity would be needed. Equally important, since peaking units commonly burn oil and gas, a reduction in peak demand would save these scarce fuels.

Accordingly, comprehensive utility reform legislation is proposed. State public utility commissions would require their regulated utilities to reform rate structures in the interest of conservation and equity. Such reform would be a prerequisite to future rate increases. The program includes the following elements:

- Electric utilities would be required to phase out promotional, declining block, and other rates that do not reflect costs; gas utilities would also be required to phase out declining block rates.
- Electric utilities would be required to offer either daily off-peak rates to each customer who is willing to pay metering costs, or provide a direct load management system. Off-peak rates would provide a strong incentive for customers, particularly industrial customers, to shift energy use from peak to off-peak periods. Similarly, homeowners would have an incentive to wash dishes and clothes at night when rates were lower, or to install equipment that stores energy during off-peak hours for use during peak hours.
- Electric utilities would be required to offer lower rates to customers who are willing to have their power interrupted at times of highest peak demand.
- Master metering—the use of a single meter for multi-unit buildings or complexes—would generally be prohibited in new structures. Individual metering induces energy conservation, in some cases as much as 30 percent.
- Electric utilities would be prohibited from discriminating against solar and other renewable energy sources.
- the Federal Government would be authorized to adopt, and require implementation of, similar policies applicable to gas utilities.

Utility interconnections and power pools make possible economies of scale, reduction of aggregate capacity requirements, and sharing of power during emergencies. Expansion of interconnections and achievement of maximum efficiency from pools are primarily the responsibility of the utility sector, which has been active in this area.

The Federal Government will follow closely the further progress of the utility sector. A proposed amendment to the Federal Power Act would remove a major gap in the authority of the Federal Power Commission by authorizing it to require interconnections between utilities even if they are not presently under FPC jurisdiction. The FPC would also be authorized to require wheeling the transmission of power between two noncontiguous utilities across another utility's system.

SAVINGS FROM CONSERVATION

Many conservation measures can be implemented with relatively little cost. Conservation involves sacrifice mainly where a cherished prerogative is given up. Many American drivers have come to enjoy instant acceleration, but as oil becomes increasingly scarce, the highly powered automobile will become increasingly anachronistic. Some moderate sacrifice today will help avoid major jolts and far more painful sacrifices in the future.

There are many ways that individual Americans can save energy beyond those specific measures included in the National Energy Plan. Individuals can keep their homes at 78° F. during the summer and at 65° F. during the winter. They can walk or ride bicycles or join car-pools, instead of driving alone. They can combine several shopping trips into one. And, they can maintain their energy-using equipment—furnace, car, appliances—in good operating condition, so as to reduce energy waste.

The value of the proposed conservation program can be illustrated by comparing the cost of savings from conservation with the cost of oil imports. Conservation reduces the need for imported oil costing about \$13.50 per barrel through investment in insulation, lighter automobiles, clock thermostats, and other capital equipment. The costs of the capital equipment can be expressed in terms of the cost of each barrel of oil equivalent which the equipment saves. The resulting costs vary. For example, the effective cost of a barrel of oil equivalent saved under some of the Plan's proposed conservation measures are: less than \$2 for cogeneration; \$3.50 for mandatory standards for new commercial construction; and about \$7.50 for tax credits for commercial and industrial investments in energy-saving retrofits or mandatory standards for new residential construction. In short, conservation pays.

Chapter V.—The National Energy Plan: Oil and Natural Gas

Oil and natural gas are currently the nation's primary energy sources. They provide three-quarters of U.S. energy consumption, but constitute less than 8 percent of domestic reserves. National policy toward oil and gas has been erratic, complex, and ineffective. Continuing uncertainties, particularly as to price, have retarded both production and conservation investment. The United States needs a clearly defined oil and gas policy that provides both producer incentives and consumer protection.

THE CONTEXT OF OIL AND NATURAL GAS PRICING

Both oil and natural gas are now priced domestically below their marginal replacement costs, and as a result they are overused. By holding down the price of domestic oil and "rolling in" the higher price of foreign oil, the United States has actually subsidized oil imports. The entitlements program, designed to equalize the cost of foreign and domestic oil to U.S. refiners, has become an administrative nightmare. Current mandatory oil price controls are scheduled to expire in 1979; and there is great uncertainty as to what system of controls, if any, will exist in the future.

As a result of present price controls on natural gas, discount rates offered by gas utilities, and environmental concerns, large quantities of natural gas are burned by industry and utilities. Consequently, it has become unavailable for use in new homes in many areas of the country. The movement of natural gas from producing to non-producing States has been discouraged; and serious regional shortages, like the one this past winter, could occur in the future.

The time has come to recognize that, regardless of Government policy, the production of oil and natural gas will cost more in the future than it has in the past. Newly discovered fields are more expensive to develop than existing fields, and additional recovery from existing fields by nonconventional means is more expensive than recovery by conventional means.

It is also time to face up to the realities of the price of foreign oil. It has sometimes been argued that the oil-producing countries should not determine the price of oil in the United States. But, despite all the rhetoric and protestations to the contrary, the fact is that as long as a large percentage of U.S. oil consumption is imported, the world

price of oil will continue to be the real cost to the U.S. economy of every extra barrel consumed.

In 1973-74, the oil-producing countries raised the world oil price fourfold. Deregulation of oil and gas prices would make U.S. producers the beneficiaries of those arbitrary price rises, and yield windfall profits from the increased value of oil and gas in existing fields. The producers have no equitable claim to that enhanced value because it is unrelated to their activities or economic contributions.

Government policy must now address the fundamental economic facts of oil and natural gas supply, and the deficiencies and uncertainties of the current system of price controls. It should provide for prices that encourage development of new wells through a more effective distribution of production incentives, but should also prevent windfall profits. It should protect consumers from profiteering, but should also promote conservation by confronting them with the real cost of oil and gas in the energy marketplace.

To achieve these purposes, a new system for pricing oil and natural gas is required. The Administration is proposing a system under which price controls would be made more consistent with national energy policies. Producers would be given adequate price incentives for development of new fields. A crude oil equalization tax would bring the cost of domestic oil up to the world price. It would raise the price of oil to its true replacement cost, and thereby encourage conservation. The proceeds of the tax, which represent the enhancement of value of domestic oil caused by OPEC price increases, would be distributed to the American people on an equitable basis.

Price controls on natural gas would be reformed as a first step toward market pricing through a formula that relates the price of gas to the price of oil.

OIL PRICING

Under the Energy Policy and Conservation Act (EPCA) passed in December of 1975, producers generally are subject to a price ceiling of either \$11.28 per barrel for new oil, or \$5.25 per barrel for old oil. These pricing regulations encourage additional production from existing fields. However, oil from higher cost new field development is denied the full incentive of the \$13.50 world price.

The President's position has been that price controls on oil should be retained as long as world oil prices remain subject to arbitrary control, and domestic supplies are insufficient to meet domestic needs. Therefore, the Plan calls for creation of a new long-range pricing system.

The price of newly discovered oil would be allowed to rise over a 3 year period to the current 1977 world oil price, adjusted to keep pace with the domestic price level. Thereafter, the price of newly discovered oil would be adjusted for subsequent inflation. This measure

would establish a domestic incentive price for frontier oil, separate from post-1977 OPEC world prices.

The incentive price would be limited to new discoveries by a definition of "new oil" applicable to oil produced from any well more than 2½ miles from a currently existing onshore well. A well more than 1,000 feet deeper than any existing well within a 2½-mile radius would also qualify for the new oil price. Offshore, only oil discovered on new Federal leases granted on or after April 20, 1977, or old leases which had been abandoned and are subjected to re-leasing by the Government would qualify for this new price.

This price should provide all the incentives needed for the development of new oil production in the United States. It would yield one of the highest production incentives available to producers anywhere in the world. It is more, for example, than the level of producer revenues in the North Sea, where exploration takes place in extremely deep water and thirty-foot waves are commonplace.

There is little or no basis for the assertion that the only reasonable price for all domestic production is the world oil price. In addition to enjoying under this program one of the highest incentives for new oil production available to any producers in the world, the domestic oil industry would find it difficult in the short-run to utilize additional incentives due to physical limitations on the availability of drilling rigs and related equipment. It would make little sense to provide incentives that could not be fully used. This pricing approach would provide the incentives in the future that would produce more energy, rather than increasingly expensive energy.

The increase in producer revenues from new discoveries of oil would provide an incentive for new production, while ensuring that there would be no windfall profits on conventional production from existing wells. Total deregulation would result in a massive transfer of income from the American public to the oil and gas producers, amounting to \$14 to \$15 billion, nearly 1 percent of the U.S. gross national product.

The \$5.25 and \$11.28 price ceilings for previously discovered oil would be allowed to rise at the rate of inflation. Where it could be shown on a case-by-case cost basis that the \$5.25 ceiling makes production from a marginal well uneconomic, that well would be eligible for the \$11.28 price ceiling.

Stripper wells and new tertiary recovery from old fields would receive the world oil price.

In order to ensure that market decisions by consumers are based on the real value of oil, all domestic oil would become subject at the well-head in three stages over a 3 year period to a crude oil equalization tax equal to the difference between its controlled price and the world price. The first increment of the tax would be applied on January 1, 1978, with two subsequent increments on January 1, 1979 and January 1, 1980. Once the full tax was in place, it would increase in accordance

with the world price of oil. However, authority would exist to prevent increases in the tax if the world price increased significantly faster than the level of domestic prices.

To protect consumers, net revenues from the equalization tax would be returned to them in the form of a per capita energy credit against other taxes or in the longer run as part of general tax reform. These "energy payments" would result in lower withholding from weekly paychecks to make it unnecessary to wait a full year for the benefit of the energy credit. The poor who do not pay taxes would also be entitled to their per capita share of these tax revenues. Most would receive their payment through existing income maintenance programs. The remainder would collect their energy payment by applying to one of the existing State agencies through which Federal funds are now distributed. It would be up to each State to designate which agency, or group of agencies, would have the responsibility for distributing energy payments. If the funds from the equalization tax were distributed on this basis in 1980, when the tax is fully in effect, a family of four would receive \$188 in energy payments. Home heating oil users would receive an additional share of the equalization tax as a dollar-for-dollar reduction in price when they buy fuel oil.

The oil tax would establish a more realistic energy pricing system, with no net gain to the Treasury, and no net loss to consumers as a group. Once the tax is fully in effect, all domestic oil would have the same price (after tax), and the entitlements program would be terminated, and certain related regulatory activities could be phased out. The entitlements program would be retained in a standby status.

NATURAL GAS PRICING

The Natural Gas Act never contemplated the dramatic increase in demand for natural gas which has resulted from the sudden quadrupling of the world price of oil in 1973-74 and from growing environmental concern in recent years. As a result of regulation under that Act, natural gas is now substantially underpriced, and there is excess demand. Existing supplies are being wasted on nonessential industrial and utility uses. A pricing policy which evolved at a time when gas was a surplus by-product of oil production is no longer sensible in a world where gas is a premium fuel in short supply.

Natural gas price regulation based on historic costs was workable when there were abundant supplies of natural gas. Similarly, the distinction between the unregulated intrastate and regulated interstate markets made little practical difference as long as gas was a cheap, surplus fuel. Producer claims that historic cost-based regulation is no longer appropriate for a premium fuel in short supply are fundamentally correct. But for precisely the same reason, the intrastate-interstate distinction has also become unworkable, indeed intolerable, as the limited amount of new gas increasingly flows to the unregulated intra-

state market at the expense of interstate consumers. The shift in the natural gas market from surpluses to shortages requires the abandonment of historic cost-based regulation and of the artificial distinction between interstate and intrastate markets.

Therefore, a new commodity value pricing approach is proposed that applies to all new gas wherever it is used. It recognizes that prices should reflect the costs and the degree of risk associated with finding replacement supplies. This approach also recognizes the need to provide a sufficient incentive for the development of future supplies with substantially higher long-range development costs. By helping bring natural gas supply and demand back into balance, this pricing proposal would be a first step toward deregulation. If the natural gas market could be brought into better balance by the mid-1980's, it might be possible and desirable to move further toward establishing full market pricing.

Under this proposal, all new gas sold anywhere in the country from new reservoirs would be subject to a price limitation at the Btu equivalent of the average refiner acquisition price (without tax) of all domestic crude oil. That price would be approximately \$1.75 per thousand cubic feet (Mcf) at the beginning of 1978. New gas entitled to this incentive price would be limited to truly new discoveries. Gas from onshore wells more than 2½ miles from an existing well, or 1,000 feet deeper than any existing well within a 2½-mile radius, would qualify for the new gas price. Offshore, only gas produced from wells on new Federal leases granted on or after April 20, 1977, or old leases which had been abandoned and are subject to re-leasing by the Government would qualify for this new price.

The country would also move toward a single national market for gas, like that now existing for oil. For new production the interstate-intrastate distinction would be eliminated, together with the resulting distorting effect on both production and distribution. Currently flowing natural gas would be guaranteed price certainty at levels currently set by the Federal Power Commission, with adjustments in accordance with changes in the GNP deflator. The Government would have authority to establish higher incentive pricing levels for specific categories of high-cost gas, such as gas from deep drilling, geopressurized zones, and tight formations.

The Federal Power Commission would be given new, more flexible standards for determining the price of natural gas made available at the expiration of existing interstate contracts or by production from existing reservoirs in excess of contracted volumes, but in no case would such gas qualify for a price in excess of the \$1.42 per Mcf ceiling (plus inflation). Gas made available under the same circumstances from existing intrastate production would qualify for the same price as new supplies of gas, that is, a price no greater than the domestic oil Btu equivalent. Existing intrastate contracts would not be affected. Because

States already regulate intrastate pipelines, Federal jurisdiction would not be extended to them except for purposes of allocation during national supply emergencies. This new gas pricing system would increase the supply of gas in the interstate market without precipitously drawing gas away from the intrastate market.

Federal pricing policy would also discourage use of gas by industry and utilities. The wellhead cost of the more expensive new supplies would all be allocated initially to industrial users, not to residential and commercial users, because the latter have far less capacity than industrial consumers to convert to other fuels.

In addition to these wellhead pricing changes, taxes would be levied on the use of oil and gas by industry and utilities, in order to encourage conservation and conversion to coal and other fuels. High volume industrial and utility users of natural gas, except for fertilizer manufacturers and certain agricultural users, would be subject to a use tax. The tax would increase the price of gas to industrial and utility users by about one-third above the Btu equivalent price of world oil over the next 5 years. Utility and industrial users of oil would also be subject to a phased-in conservation and conversion tax ranging from 90 cents to \$3.00 per barrel. These measures are discussed in more detail in Chapter VI.

Federal Power Commission jurisdiction would be extended to certain synthetic natural gas facilities. However, the higher price of synthetic natural gas would not be rolled in with the price of natural gas, but rather would be allocated to industrial customers.

It will be at least 3 years before these proposals can significantly improve the natural gas supply situation. Until then, the U.S. will remain vulnerable to natural gas supply emergencies during the coldest months of the year. Because it was needed to keep American homes warm this past winter, the current emergency gas allocation authority would be extended for another 3 years. The need for that authority will be reviewed as the natural gas market comes into better balance.

This pricing approach acknowledges that the true economic value of a depleting resource is its replacement cost. The proposed pricing system would provide the price incentives natural gas producers need and protect homeowners from natural gas prices in excess of levels needed to maintain production.

For both oil and gas, this approach establishes an integrated pricing system that places the incentives on harder to find, new supplies, while ending the distortions of the interstate-intrastate distinction for new natural gas. It provides no reward to any firms that may have withheld natural gas last winter. Under the Plan, there would be about as much gas, oil, and conservation as would result under total deregulation.

lation. But, in addition, windfall profits would be prevented, realistic market prices for energy would be established, and part of the higher retail price of oil would be distributed to the American people.

ALASKAN OIL

By the end of 1977, the Alaska pipeline terminal in Valdez, Alaska, should be receiving approximately 1.2 million barrels of oil per day. The current capacity for absorbing additional crude oil on the West Coast is no more than 600,000 to 800,000 barrels per day, leaving another 400,000 to 600,000 barrels of Alaskan oil as surplus.

Active Federal and State involvement will be necessary to assure expedited construction of the best project or combination of projects for receiving Alaskan oil on the West Coast and moving it in an environmentally sound way to inland markets where it is needed. A Federal project coordinator has been designated to coordinate Federal involvement and to work with States in ensuring timely and thorough review of all proposals in order to expedite projects. The Administration will consult with the Canadian Government to encourage timely Canadian consideration of projects that could be constructed in that country.

As the United States reviews its options for transporting Alaskan oil, it is important that the needs of midcontinent and northern tier refiners be taken into account along with those of refiners on the West Coast. The establishment of a long-term transportation system for supplementing supplies in these regions is a matter of high priority. An assessment will also be made of all options that would enable the U.S. to benefit from Alaskan oil in the short term until permanent transportation systems are in place. The options include transshipment of surplus crude to Gulf Coast markets as well as exchanges with other nations.

The 500,000 barrels per day of imports now expected to arrive on the West Coast could also be phased out by a refinery retrofit program that, over the course of the next several years, would enable more high-sulfur Alaskan oil to be refined in California.

In order to reduce the West Coast oil surplus, legislation will also be sought to provide authority to limit production from the Elk Hills Naval Petroleum Reserve to a ready reserve level. This action could reduce the West Coast surplus until the west-to-east transportation systems for moving the West Coast crude surplus are in place or California refiners have completed a major retrofit program. In the meantime, studies will be undertaken to determine the feasibility of producing and selling natural gas from Elk Hills to supply California markets.

Without a comprehensive oil pricing approach, inclusion of Alaskan North Slope oil production in the domestic composite price would

introduce a degree of unnecessary uncertainty into domestic crude oil pricing. Because the large volume of new Alaskan oil would initially be moving into the composite average at a wellhead price considerably below the current average, its inclusion could allow price increases in other tiers in the short term. Under the Plan's proposed regulations, this problem would be eliminated. The \$5.25, \$11.28, and new oil pricing tiers would be guaranteed increases consistent with inflation. Alaskan oil from already developed fields would be subject to an \$11.28 wellhead ceiling price, would be exempt from the equalization tax, and would be treated like uncontrolled oil for purposes of the entitlements program until that program is terminated. New Alaskan discoveries would be subject to the new oil wellhead price.

This program grants maximum and certain wellhead price incentives for Alaskan oil production.

OUTER CONTINENTAL SHELF

Oil and gas under Federal ownership on the Outer Continental Shelf (OCS) are important national assets. It is essential that they be developed in an orderly manner, consistent with national energy and environmental policies. The Congress is now considering amendments to the OCS Lands Act, which would provide additional authorities to ensure that OCS development proceeds with full consideration of environmental effects and in consultation with States and communities. These amendments would require a flexible leasing program, using bidding systems that will enhance competition, ensure a fair return to the public, and promote full resource recovery. The Administration strongly supports passage of this legislation.

The President has also directed the Secretary of the Interior to undertake a review of OCS leasing procedures. This review will establish a sound basis for the leasing program and assure adequate production from the OCS, consistent with sound environmental safeguards.

SHALE OIL

Billions of barrels of oil may some day be recovered from shale deposits in Western States if environmental and economic problems can be overcome. Several private firms have announced that they believe they can solve these problems, and that they are prepared to proceed with shale oil development. These commercial ventures should provide valuable information about the viability of a shale oil industry.

Due to the high risks and costs involved in shale oil development, the Government should establish a pricing policy that provides adequate incentives to producers. Accordingly, shale oil will be entitled to the world price of oil.

LIQUIFIED NATURAL GAS

The Energy Resources Council in the previous administration proposed guidelines to limit imports of liquefied natural gas to 2 trillion cubic feet per year. Of that, no more than 1 trillion cubic feet could be imported from any one country. Applications for LNG contracts now pending before the Federal Power Commission already approach the 2-trillion-cubic-feet limitation, with over 1.2 trillion cubic feet proposed to come from Algeria.

Due to its extremely high costs and safety problems, LNG is not a long-term secure substitute for domestic natural gas. It can, however, be an important supply option through the mid-1980's and beyond, until additional gas supplies may become available.

The previous Energy Resources Council guidelines are being replaced with a more flexible policy that sets no upper limit on LNG imports. Under the new policy, the Federal Government would review each application to import LNG so as to provide for its availability at a reasonable price without undue risks of dependence on foreign supplies. This assessment would take into account the reliability of the selling country, the degree of American dependence such sales would create, the safety conditions associated with any specific installation, and all costs involved. This action could add as much as 500 billion to 1 trillion cubic feet annually to U.S. gas supply through the 1980's, without making an open-ended commitment for large volumes of this expensive resource.

The new policy further provides for distribution of imports throughout the nation, so that no region would be seriously affected by a supply interruption. It also provides for the development of contingency plans for use in the event of a supply interruption. In cases where the proposed supplier retains a unilateral right to cut off supply, consideration should be given to conditioning FPC certification on recognition of a reciprocal right to cancel on the part of the U.S. purchaser.

Finally, strict siting criteria would foreclose the construction of other LNG docks in densely populated areas.

SYNTHETIC NATURAL GAS

The nation's current policy toward synthetic natural gas (SNG) made from petroleum feedstocks is not satisfactory. Existing regulations favor the allocation of naphtha and other potential SNG feedstocks to the petrochemical industry, and effectively preclude their use by gas utilities. This policy has discouraged the construction of new SNG plants. Yet, the 13 SNG plants that were operating this winter provided the additional margin of natural gas supply that kept

several areas of the country from shutting off residential users during the coldest months.

Therefore, a Federal task force will be created to work with the gas utilities to identify those areas of the country where a limited number of additional SNG plants should be built to help meet the critical peakload needs for gas over the next 5 to 7 years. Federal Energy Administration regulations will be revised to provide a priority for SNG feedstocks to those plants approved by the task force. This regulatory change will give pipeline companies and utilities the reasonable certainty they need to make investments for this short-term source of gas supply.

SNG plants could contribute almost 1 trillion cubic feet of gas annually in the 1980's.

NEW SOURCES OF NATURAL GAS

Additional funding in fiscal year 1978 is proposed to encourage private efforts to tap the potential of two resources that may produce considerable quantities of natural gas in the near and mid-term.

To evaluate the technology and economic viability of Eastern Devonian shale deposits, a number of wells will be drilled and advanced recovery will be tested. In addition, the institutional and regulatory arrangements needed to assure effective use of this resource will be studied.

ERDA will assess the dissolved gas potential in the geopressurized zones along the coast of the Gulf of Mexico. The proposed research program is designed to provide a reliable assessment of this resource and to help resolve corrosion and other problems associated with it. The significant environmental and institutional barriers to extensive development of the geopressurized resource will also be examined.

New gas from these sources could materially alter the outlook for U.S. gas supply. Successful development of these resources could provide enough additional gas to assure supplies for residential and commercial use for years to come.

STUDY OF THE NATIONAL ENERGY TRANSPORTATION SYSTEM

During the era of cheap energy, the United States developed a national energy transportation system principally for moving oil and natural gas from the South and the Texas Panhandle to the North and Northeast. With growing prospects for increased supplies of oil and gas from the Outer Continental Shelf, as well as the anticipated increases in coal production, the nation urgently needs to reassess its energy transportation system. It is clear that the energy transportation routes built in the first half of this century will have to be supplemented

by new routes capable of moving the projected mix of energy supplies in 1985 to market. Therefore, the President will create a commission to study the nation's energy transportation needs and to make recommendations to him by the end of this year. One purpose of the study will be to develop means to encourage use of energy supplies nearest to consuming markets, such as eastern coal, in order to reduce the need for long-distance transport.

GASOLINE DECONTROL

Gasoline allocation and price controls are another major area of unsettled oil policy. Gasoline prices have never reached their allowable controlled ceilings, and marketers have contended for some time that deregulation of gasoline would increase competition by allowing them to shop among suppliers. There is little question that gasoline allocation and price controls have distorted what at times has been a competitive market.

In order to assure the maintenance of such competition in the gasoline marketplace, the Administration will support legislation similar in concept to the pending "dealer day in court" bill that would protect service station dealers from arbitrary cancellation of their leases by major oil suppliers. In addition, the Administration currently hopes to eliminate gasoline price controls and allocation regulations at the end of the peak driving season this coming fall. Gasoline prices and market competition will be closely monitored between now and then to assure this policy is appropriate. If gasoline were to be decontrolled, controls could be reimposed if prices rose above a predetermined level. This standby authority would permit the elimination of controls while protecting consumers.

OIL IMPORTS

In February and March of this year, United States imports reached a level of about 9 million barrels of oil per day. The measures proposed in the Plan would reduce total oil demand by 4.5 million barrels per day, resulting in oil imports in 1985 averaging about 7 million barrels per day, 2 million below the levels of February and March of this year. Even with a reduction of oil imports to under 6 million barrels per day, the United States would have to take additional steps to reduce its vulnerability to supply interruptions.

As explained in Chapter III, the sensible policy goal for oil imports is relative invulnerability, not independence. The United States continues to import foreign oil because, even at the high prices set by the oil-exporting countries, it is cheaper than domestic sources of synthetic oil. To eliminate imports would be to sacrifice an economic

benefit of major proportions. Imports also reduce the depletion of America's own critical oil reserves. Moreover, by substituting for domestic production, and by obviating the need for immediate massive development of all energy sources simultaneously, imports help maintain the quality of the environment. The United States has no reason to pay the very high cost of trying to achieve energy independence. Even if the U.S. itself were independent, its allies could not be, and the U.S. would have to assist them in the event of an international oil shortage.

The key to a tolerable level of oil imports lies in reducing vulnerability by means of an adequate strategic oil reserve, diversification of foreign sources of supply, and contingency plans. The reserve must be large enough to impose substantial revenue losses on countries imposing an embargo, and to enable the United States to deal with the consequences of any supply interruption. The ability to ride out a supply interruption may reduce the likelihood that any nation or combination of nations would impose one. The availability of the Strategic Petroleum Reserve would help offset the adverse economic effects of a supply interruption.

Accordingly, the U.S. plans to expand the Strategic Petroleum Reserve from the currently projected 500 million barrels to the 1 billion barrel level. Assuming that vigorous conservation measures, including rationing, would be undertaken during a supply interruption, and assuming further that a number of OPEC and non-OPEC nations would not participate in the supply interruption, the reserve is designed to supply somewhat more than 3 million barrels per day. Under these assumptions, a 1 billion barrel reserve would last at least 10 months. This reserve is the best kind of insurance the United States could buy, since it is unlikely that the price of oil will fall in the foreseeable future.

An effective policy to reduce vulnerability to supply interruptions also requires diversification of the sources of oil imports. Some developing countries with major petroleum reserves find it difficult to deal directly with multinational oil companies. Yet such countries need capital and sophisticated technology of the kind U.S. firms could supply, as well as the revenues that resource development would bring. The United States recognizes that government-to-government negotiations may be helpful in dealing with the wide variety of potential obstacles that currently prevent these nations from making a significant contribution to world oil supplies.

Finally, the United States must put in place effective contingency plans. The Administration is transmitting to the Congress a standby rationing plan and demand restraint plans to be available in the event of a national emergency resulting from a supply interruption. The impacts on particular industries and sectors of society would be

substantial. But the contingency plans would be implemented only under conditions of extreme national emergency, when substantial sacrifices in the national interest would be justified. In addition, the Administration is accelerating the preparation of additional contingency plans. These plans would reach all sectors of American life: industry, commerce, transportation, residences, and the public sector. Should a national energy emergency occur and the plans have to be invoked, the burdens would be shared widely and fairly among all Americans.

Chapter VI.—The National Energy Plan: Coal, Nuclear, and Hydroelectric Power

Even with vigorous conservation, America's demand for energy will continue to grow. The United States will need increased domestic energy production if it is to avoid shortages and unacceptable levels of imports. The U.S. eventually will make extensive use of solar and other nonconventional energy sources. During the remainder of this century, however, it will have to rely for the bulk of its energy supply on the conventional sources now at hand: oil, natural gas, coal, nuclear, and hydroelectric power. Federal policy should stimulate the expanded use of coal, supplemented by nuclear power and renewable resources, to fill the growing gap created by rising energy demand and relatively stable production of oil and gas.

COAL

Conversion to Coal and Alternative Fuels

Industry and utilities consumed 4.8 million barrels of oil per day and 5.9 million barrels of oil equivalent per day in the form of natural gas in 1976. Oil and natural gas are scarce, and generally they are needed more by other sectors of the economy. Industry and electric utilities can convert to other energy sources more readily than can other users; therefore, a large-scale conversion by industry and utilities from oil and gas to more abundant resources is needed.

Coal constitutes 90 percent of U.S. conventional energy reserves, but currently supplies only 18 percent of energy consumption. It is generally acknowledged that the coal industry can expand production significantly, and currently has a small amount of excess capacity. (See Figure VI-1.) Full utilization of America's coal resources has been hindered principally by constraints on demand, rather than by lack of supply.

Source: U.S. Bureau of Mines and Federal Energy Administration.

Figure VI-1

Questions have been raised about the adequacy of the nation's transportation system to deliver increased quantities of coal. With the exception of a few areas, it appears that railroads could transport the additional coal. The coal transportation situation will be considered as part of the study of the national energy transportation system. In addition, the Federal Government will monitor coal transportation carefully; and if problems should appear, it will take appropriate action.

Coal development and production is most economical when it is near major markets. Although coal production will expand in many areas, there should be large production increases in the highly populated Eastern and Mid-West regions, where coal use in industry and utilities could grow considerably in the future. The required use of best available control technology for new powerplants should stimulate even greater use of high sulfur Mid-Western and Eastern coals.

Expansion of U.S. coal production and use is essential if the nation is to maintain economic growth, reduce oil imports, and have adequate supplies of natural gas for residential use. Accordingly, to stimulate an increase in demand for coal and other alternatives to gas and oil, the Plan proposes a coal conversion program consisting of tax and regulatory measures.

The tax measures are designed to raise the cost of gas and oil to industrial and utility users, and to provide positive incentives for conversion to other sources of energy. A tax would be levied on industrial and utility use of natural gas and petroleum products. Beginning in 1979, high volume industrial users of natural gas (except fertilizer manufacturers and certain agricultural users) would be affected. They would be taxed an amount equal to the difference between their average cost of natural gas and a price target keyed to distillate oil (without the proposed tax on utility and industrial use of petroleum products). The price of distillate is one third higher than the world price of crude oil. The target level for the first year's tax in 1979 in constant dollars would be \$1.05 below the Btu equivalent price of distillate. The target price would rise to the distillate prices in 1985 and beyond.

Thus, in 1979, an industrial user who paid \$1.65 per Mcf for gas would pay a tax of \$0.30 per Mcf to bring the total cost of gas up to the target level of \$1.95 per Mcf, assuming the Btu equivalent price of distillate would be \$3.00. By 1985, the target level would rise to approximately \$3.30 per Mcf, the projected Btu equivalent price for distillate, resulting in an average tax of \$1.10 per Mcf based on a projected actual gas cost of \$2.20 per Mcf. Utility users of natural gas would be similarly taxed starting in 1983, at an amount that would bring their cost of gas to a level of \$0.50 per Mcf below the Btu equivalent price of distillate. The tax would rise so that by 1988 their cost of gas would

equal the cost of the Btu equivalent amount of distillate. The later starting date for the tax on utility use of natural gas reflects the longer lead time required by utilities to convert to coal.

Industrial and utility users of petroleum products would be taxed at a flat rate since, unlike natural gas prices, petroleum prices are relatively uniform nationwide. Beginning in 1979, industrial use would be taxed \$0.90 per barrel; the tax would rise to \$3.00 per barrel by 1985. A tax on utility use of petroleum products would begin in 1983 at \$1.50 per barrel and remain at that level thereafter.

Industry would generally be eligible, at its election, for either an additional 10 percent investment tax credit for conversion expenditures or a rebate of any natural gas or petroleum taxes paid, up to the amount of any expenditures incurred for conversion to coal or other fuels. With tax liability delayed until 1979 for industry and 1983 for utilities, prudent investors undertaking an aggressive conversion program should be able to accumulate enough conversion credits to eliminate, or minimize, the actual amounts of tax paid. Only those industrial firms and utilities which lagged behind in conversion would pay substantial taxes.

The Plan also proposes a revised and simplified regulatory program for oil and natural gas conversions. Industry and utilities would be prohibited from burning natural gas and petroleum products in new boilers, with limited environmental and economic exceptions. Industrial firms also could be prohibited from burning gas or petroleum in new major fuel-burning installations other than boilers, by regulations applicable to categories of installations, or on a case-by-case basis. Such orders would be subject to the same limited environmental and economic exceptions.

Existing facilities with coal-burning capability could be prohibited from burning gas or oil, where the burning of substitute fuels would be economically feasible and environmentally acceptable. Facilities burning coal would be required to obtain a permit in order to shift to petroleum or natural gas. Utilities burning gas would require a permit to shift to petroleum instead of coal. By 1990, virtually no utility would be permitted to burn natural gas.

Any industrial firm or utility prohibited from using natural gas would be allowed to sell its contract to purchase gas at a price that would compensate it fully for shifting to petroleum on an interim basis or to coal on a longer term basis.

These regulatory proposals closely resemble a bill sponsored by Senators Jackson, Humphrey, and Randolph. The Administration looks forward to working closely with the Congress to develop an effective fuel conversion program.

Environmental Policy

Attainment and maintenance of the environmental goals set out in the Clean Air Act, the Federal Water Pollution Control Act, and the National Environmental Policy Act are high national priorities. The Administration intends to achieve its energy goals without endangering the public health or degrading the environment.

The Administration has indicated its position regarding a series of amendments to the Clean Air Act. Utilities and industrial facilities will be asked to convert to coal without sacrifice of air quality standards. It is recognized that, in areas with serious air pollution problems, it may be necessary to continue burning oil in order to protect public health. The Administration is conducting a research and development program that will produce new technologies that allow the clean burning of coal more efficiently.

A strong but consistent and certain environmental policy can provide the stability needed to encourage investment in new energy facilities. The Administration has taken a position that all new facilities, including those that burn low sulfur coal, should be required to use the best available control technology.

The Administration has also supported an amendment to the Clean Air Act which would prevent significant deterioration of air quality in areas where air is now cleaner than required by air quality standards. It is committed to protecting national parks and other pristine Federal lands. In order to provide a necessary measure of certainty for the development of new energy facilities, the Administration has recommended adoption of a provision which would encourage States to classify their lands into the various categories within 3 years for protection against significant deterioration. After these initial designations are made, a new energy facility would be subject to those classifications and requirements in effect at the time of application, unless the Governor of the State served notice of an intent to change the classification within 120 days. If a classification is to be changed, the State would be required to complete the redesignation within 1 year. By reducing the amount of time during which the ground rules for locating energy facilities can change, Government would enable energy planning to proceed in a more orderly and expeditious way.

The Environmental Protection Agency will review its current policies allowing offsetting pollution tradeoffs for new installations locating in areas which violate the primary ambient air quality standards. Although the current policy may prove to be the most reasonable strategy for permitting new growth while maintaining progress toward attainment of air quality goals, alternatives should also be

explored. The Administration has recommended that no new legislative requirements be adopted in this area until the review is completed. In the interim, the existing EPA policy will be retained.

Some uncertainty will continue over the environmental impacts of an increasing number of coal-burning plants, even those equipped with the best available control technology. Accordingly, the President will appoint a special committee to study the health effects of increased coal production and use, and the environmental constraints on coal mining and on the construction of new coal-burning facilities. The committee will report to the President by next October. In addition, nearly \$3 million is being requested to study the long-term effects on the atmosphere of carbon dioxide from coal and other hydrocarbons.

The Administration has recognized the need to protect land and water quality against unwarranted damage resulting from inadequate reclamation of strip mined areas. It continues to support uniform national strip mine legislation that would fully protect the nation's land while permitting the production of coal that is needed to meet national energy objectives.

Coal Research

Coal will meet the greatest portion of increased U.S. energy needs. A comprehensive coal research and development program is a high priority. The program should focus on meeting environmental requirements more effectively and economically, and should seek to expand the substitution of coal for natural gas and petroleum products.

In the short term, most coal will continue to be burned directly. Hence, the highest immediate priority is the development of more effective, economical methods to meet air pollution control standards. Some flue-gas desulfurization (FGD) systems, or "scrubbers," are already in commercial use. Work will continue on overcoming generic operating problems encountered by these systems. A number of new systems are under development, and the Government will undertake a 6 month review to determine whether the new technologies offer sufficient environmental, cost and reliability advantages to justify accelerating the RD & D program. Research into fluidized-bed combustion systems for the direct burning of coal in an environmentally superior manner is being expanded.

In addition, increased research will be devoted to developing means to control the fine particulate and sulfur oxide emissions associated with coal burning. In many situations, front-end coal cleaning by grinding and washing can reduce the free sulfur and ash content and thereby reduce the cost of meeting environmental stand-

ards. Accordingly, the Government will expand its current research and demonstration program for coal cleaning to determine what additional efforts are needed to meet sulfur oxide and particulate standards more economically.

Solvent refined coal processes use chemical means to remove even more of the sulfur content. The Government will initiate the design of a commercial-size demonstration solvent refined coal plant in fiscal 1978. If, as expected, pilot plant technical and economic feasibility is demonstrated, construction of a commercial-size plant will proceed.

Pursuant to the Administration's February budget revisions, the Government is proceeding with demonstration projects to develop on a commercial scale techniques for deriving low Btu gas from coal. For example, a large gasification project at a Minnesota ore plant and another at a Pennsylvania zinc smelter have been selected for Government and industry cost-sharing demonstrations. Low Btu gasification processes produce a coal-derived industrial quality fuel that avoids the need for back-end sulfur oxide and particulate control. That fuel could be a major aid in meeting coal conversion objectives.

In the long run, high Btu synthetic gas produced from coal may provide a substitute for declining natural gas supplies. The Administration will pursue an active RD&D program for high Btu coal gasification using advanced technologies. The program will be conducted with the urgency required to ensure that the new technology will be ready when needed.

The basic Federal role in this process is research, development and demonstration of new technologies. In general, the Government seeks to avoid subsidization of existing technologies, although circumstances may sometimes merit an exception to that policy.

The technology for producing synthetic crude oil is not as well developed as synthetic gas technologies. An active RD&D program, including pilot plant demonstrations, will be pursued. The Federal Government currently is providing some of the funding for a 600-ton per day, coal-to-oil pilot facility in Kentucky.

Funding authority for the overall coal program would amount to \$527 million in fiscal 1978, and would continue at substantial levels. The success of this program in developing and commercializing new coal technologies will reduce the pressure on dwindling oil and gas supplies. The new coal technologies are critical to the National Energy Plan, both as an immediate aid in converting from scarce to abundant resources and as a future source of synthetic oil and gas.

NUCLEAR POWER

Many countries view nuclear power as their only real alternative to dependence on costly and uncertain oil and gas imports. The United States is in a better position, primarily because of its vast coal re-

sources. Coal does, however, have economic, environmental, and health and safety limitations; and, therefore, the United States also must continue to count on nuclear power to meet a share of its energy deficit.

Light-water reactors provide a proven technology to produce needed electrical power. However, more advanced forms of nuclear power may entail significant risk, and must therefore be developed cautiously. The United States has been concentrating on the development of a breeder reactor that uses plutonium, a by-product of uranium in nuclear reactors. In addition, the United States has been developing reprocessing technology to recover the uranium and plutonium in the spent fuel from light-water reactors. Access to plutonium, or even the capacity to recover or isolate it, can lead to the risk of diversion of material that could be used for nuclear explosive devices. The United States should develop advanced nuclear technologies that minimize the risk of nuclear proliferation, but with the knowledge that no advanced nuclear technology is entirely free from proliferation risks.

It is the President's policy to defer any U.S. commitment to advanced nuclear technologies that are based on the use of plutonium, while the United States seeks a better approach to the next generation of nuclear power than is provided by plutonium recycle and the plutonium breeder. At the same time, because there is no practicable alternative, the United States will need to use more light-water reactors to help meet its energy needs. The Government will give increased attention to light-water reactor safety, licensing, and waste management so that nuclear power can be used to help meet the U.S. energy deficit with increased safety.

Proliferation is a world-wide problem. The President announced on April 7, 1977 that the United States will make a concerted effort in association with other countries to find better solutions to this problem. For its part, the United States has adopted two policies. First, it will refrain from proceeding with nuclear technologies that present a high risk of proliferation. To this end, the United States will defer indefinitely commercial reprocessing and recycling of plutonium, as well as the commercial introduction of the plutonium breeder. Second, the President is proposing to reduce the funding for the existing breeder program and to redirect it toward evaluation of alternative breeders, advanced converter reactors, and other fuel cycles, with emphasis on nonproliferation and safety concerns. He also is proposing to cancel construction of the Clinch River Breeder Reactor Demonstration Project and all component construction, licensing, and commercialization efforts. The design work would be completed, and a base level program would be maintained, including the Fast Flux Test Facility. These actions would not seriously affect long-term

energy supplies in the United States. There is, of course, some price to be paid in redirecting this program, but that price is clearly outweighed by the dangers of proceeding.

The United States hopes that these actions will encourage other nations to pause in their development of plutonium-based technology and to examine alternative methods of meeting their future energy needs.

The United States recognizes that for this pause to be feasible, other nations must have assured supplies of slightly enriched uranium required for light-water reactors. The United States must restore confidence in its willingness and ability to supply enrichment services. The Administration, therefore, is prepared, in cooperation with the Congress, to take three steps that will substantially improve confidence in the U.S. position:

- reopen the order books for U.S. uranium enrichment services;
- adopt legislation to guarantee the delivery of enrichment services to any country that shares U.S. nonproliferation objectives and accepts conditions consistent with those objectives;
- expand U.S. enrichment capacity.

Current U.S. enrichment capacity consists of three gaseous diffusion plants which use a technology first developed more than 30 years ago. The time has come to move to the new gaseous centrifuge technology, which consumes less than 10 percent as much electrical power as a diffusion plant of equivalent capacity. In addition, a centrifuge plant has the potential for producing enriched uranium at lower cost. Therefore, the next U.S. enrichment plant, for which funds are already in the proposed fiscal 1978 budget, will be a centrifuge plant.

Light-water reactors require a supply of natural uranium. Current estimates of U.S. uranium resources range between 1.8 and 3.7 million tons. The uncertainties about the extent of domestic uranium resources should be resolved. The Energy Research and Development Administration will reorient its National Uranium Resources Evaluation Program to improve uranium resources assessment. The program will also include thorium, which may be used to breed fuel in some of the advanced nuclear technologies. This program will be a cooperative effort with industry, the States and the U.S. Geological Survey.

Today, 63 nuclear power plants provide about 10 percent of the U.S. supply of electricity. By 1985, an additional 75 nuclear plants already planned or in construction could be in operation, and nuclear power could provide as much as 20 percent of electricity supply.

Thus, the United States has the option of relying on light-water reactors to provide nuclear power to offset a share of the nation's energy deficit without undue risk of proliferation. However, as with

any energy technology, there are risks in the operation of light-water reactors. Although the safety record of light-water reactors has been good, several additional actions can be taken to improve safety.

To protect against possible diversion of nuclear material and against sabotage, the Nuclear Regulatory Commission has already increased the required number of guards at plants and the requirements for the training that guards receive. To improve the overall safety of light-water reactors, the President is requesting that the Commission expand its audit and inspection staff to increase the number of unannounced inspections and to assign one permanent Federal inspector to each nuclear power plant. The President is also requesting that the Commission make mandatory the current voluntary reporting of minor mishaps and component failures at operating reactors, in order to develop the reliable data base needed to improve reactor design and operating practice.

In addition, the President is requesting that the Commission develop firm siting criteria with clear guidelines to prevent siting of future nuclear plants in densely populated locations, in valuable natural areas, or in potentially hazardous locations. Proper siting will substantially reduce the risks of a nuclear accident and the consequences should one occur.

Reform of the nuclear licensing process is clearly needed. The present process is unsatisfactory to all participants: industry, intervenors, and the Federal Government. The President has directed that a study be made of the entire nuclear licensing process. He has proposed that reasonable and objective criteria be established for licensing and that plants that are based on a standard design not require extensive individual licensing.

In addition to licensing problems, construction delays have also contributed to the long lead-times needed to build U.S. nuclear plants. A national industry-labor agreement could lead to a substantial reduction in construction time and increase the willingness of utilities to invest in nuclear power plants.

Finally, the waste generated by nuclear power must be managed so as to protect current and future generations. Improved methods of storing spent fuel will enable most utilities at least to double their current storage capacity without constructing new facilities. Two actions have been taken to ensure that long-term waste storage facilities are available by 1985. The Energy Research and Development Administration's waste management program has been expanded to include development of techniques for long-term storage of spent fuel. Prototype technologies, complete designs, and initial environmental criteria for waste repositories will be developed by 1978. Licensing of the first

repository should be completed by 1981. There will be an opportunity for thorough public review at each of these stages. A task force under the direction of the Assistant to the President for energy will review the entire ERDA waste management program.

HYDROELECTRIC POWER

New or additional hydroelectric generating capacity at existing dams could be installed at less than the cost of equivalent new coal or nuclear capacity. Many of these sites are small, but could generate 3 to 5 megawatts, and are located near major demand centers currently dependent on imported fuel oil. Installation of additional generating capacity at existing sites could conceivably add as much as 14,000 megawatts to the nation's generating potential.

The Department of Defense (Corps of Engineers) and other responsible agencies, have, therefore, been directed to report to the Assistant to the President for energy on the potential for additional hydropower installations at existing dam sites throughout the country.

Chapter VII.—The National Energy Plan: Nonconventional Sources and Energy Research

America's hope for energy to sustain economic growth beyond the year 2000 rests in large measure on the development of renewable and essentially inexhaustible sources of energy. Many diverse solar, geothermal, biomass and other technologies are in various stages of development. Some technologies, such as solar hot water and space heating, can make contributions now. Others, such as the solar electric technologies and some forms of geothermal energy, have great promise for the future. Fusion still requires significant scientific progress before its feasibility can be demonstrated. The Government should aggressively promote the development of nonconventional resources despite the fact that they face many uncertainties. The danger of too much initial skepticism is that it may become a self-fulfilling prophecy.

SOLAR ENERGY

Solar hot water and space heating technology is now being used, and is ready for more widespread commercialization. A temporary Federal program of financial incentives and public education is needed to stimulate the development of a larger solar market. As manufacturers, installers, and consumers become more familiar with solar energy equipment, and as economies of scale are achieved, prices should be reduced. Therefore, a tax credit supported by a Federally funded public education program is proposed. The credit would start at 40 percent of the first \$1,000 and 25 percent of the next \$6,400 (for a maximum of \$2,000) paid for installation of qualifying solar equipment. The credit would decline in stages to 25 percent of the first \$1,000 and 15 percent of the next \$6,400. The credit would be available for expenditures between April 20, 1977, and December 31, 1984. The public education initiative would consist of a joint Federal-State program of standards development, certification, training, and information gathering and dissemination.

This initiative should help launch the solar heating industry. The industry would be further aided by the inclusion of investments in solar equipment among the approved conservation measures eligible for the proposed 10 percent tax credit for energy-saving investments by business. This investment tax credit should encourage the use of

solar energy for industrial and agricultural process heat and for commercial operations. Solar energy is likely to be particularly attractive for use in crop drying and other agricultural applications.

The results of the solar demonstration programs being carried out by the Energy Research and Development Administration and the Department of Housing and Urban Development and the equipment performance standards being developed by HUD should help provide a basis for warranties, insurance, and mortgage valuations. Moreover, the Federal Government will demonstrate its confidence in solar technology by undertaking a 3 year program of up to \$100 million for installation of solar equipment in Federal buildings.

The States should also support widespread use of solar energy. A number of them have already amended their property tax laws to exempt solar installations from assessments. It is desirable that the other States do so as well. The States are also encouraged to enact legislation to protect access to the sun and to promote consumer education in the solar field. Under the proposed utility reform program, State public utility commissions would develop guidelines to prevent utilities from discriminating against users of solar energy.

Energy from the sun can also be used without any equipment at all. Through building orientation and design, choice of materials, location of trees and hedges, and other means, "passive" solar systems can be used to obtain heat from the sun when it is needed and to reject it when it is not. More widespread use of passive solar systems would help to reduce fuel bills and conserve conventional fuels.

Solar energy can also be used to generate electricity. The solar electric technologies are in varying stages of development. Photovoltaic systems, using cells developed in the space program, are economic today for certain small, decentralized applications. These systems have a potential for dramatic price reductions that would make them economical for a broader range of applications. Increased funding is proposed to accelerate the development of economic photovoltaic systems. Longer term development is proceeding on central station solar electric power systems. Collection of solar energy by space satellites has been proposed, and the concept deserves further study.

Various technologies make indirect use of solar energy, in the form of wind, agricultural and forestry residues ("biomass"), and ocean thermal energy (the heat captured by the ocean surface). Wind and biomass can make significant regional contributions in the medium term. Wind systems can supply energy to small utilities, hydroelectric systems, and dispersed users of power. Agricultural and forestry residues already are used as fuel, and that use can be increased by improved collection methods and by energy farms, in

which crops are grown specifically for use as energy. In addition, biomass can be used to produce liquid and gaseous fuels for a variety of uses.

The Plan's fuel conversion program would be an incentive for use of biomass, as well as coal. Industry and utilities would have strong reasons to shift away from oil and gas to other energy sources. Tax credits would be provided for investments in facilities to use non-conventional energy sources, as well as to use coal. The environmental problems associated with coal combustion should lead businessmen to take a close look at the advantages of using nonconventional energy sources.

Finally, the Plan's research and development program includes increased funding for biomass, small wind systems, solar cooling, and other solar technologies.

MUNICIPAL SOLID WASTE

Municipal solid waste is a valuable energy resource. Its use for energy production also helps to solve environmental problems and reduce municipal disposal costs. Energy can be obtained from municipal solid waste both through direct combustion and through systems for converting wastes into liquid, gaseous, and solid fuels ("refuse-derived fuels").

Greater use of energy recovery systems has been hindered by the availability of cheap, open dumps and by technological and institutional difficulties. However, some plants burning solid waste or producing fuel from it already operate successfully, and present barriers to more widespread use should be overcome with coordinated action by Federal, State and local governments and private firms.

The Plan's fuel conversion program would provide incentives for use of municipal solid waste and refuse-derived fuel as energy sources. Through implementation of the Resource Conservation and Recovery Act of 1976, the Federal Government will continue to help States and local governments to overcome the present barriers to more widespread use of municipal solid waste.

GEO THERMAL ENERGY

Geothermal energy, the natural heat in the Earth's crust, has a large potential for direct thermal use and for electricity generation, particularly in the Western States. It occurs in many forms, only one of which is currently used to a significant extent. Dry geothermal steam from The Geysers in California provides more than 500 MW. for northern California.

Hydrothermal (liquid-dominated) sites are found throughout the West, some at high temperatures adequate for electricity generation,

and others at lower temperatures suitable for heating of buildings. At present, several hundred buildings use geothermal heat. With expected technological progress, hydrothermal sources should begin to make a significant contribution in the 1980's.

Geopressurized resources, located along the Gulf Coast, contain potentially significant amounts of hot water and dissolved methane, which may become accessible in the 1980's. Hot dry rock may become a significant source of energy in the 1990's.

To stimulate the development of geothermal resources, legislation is proposed to extend to geothermal drilling the tax deduction for intangible drilling costs that is now available for oil and gas drilling. The purpose of this proposal is to bring about equality of treatment among activities which compete for capital. The issues concerning the overall allowance of deductions for intangible drilling costs will be reviewed as part of the President's tax reform program.

The Plan's research and development program provides additional funding to evaluate the geopressurized and liquid-dominated hydrothermal resources and to promote the use of geothermal energy in nonelectric applications.

Finally, the Department of the Interior, the Department of Agriculture, and the States will be encouraged to streamline their leasing and environmental review procedures to remove unnecessary barriers to development of geothermal resources.

FUSION

Research in controlled thermonuclear reactions ("fusion") has been a major element in energy research and development programs. However, despite many years of active research, scientific feasibility has yet to be demonstrated, though steady progress has been made in satisfying each of the individual criteria for achievement of breakeven power (the production of more power than is consumed).

Current research on magnetic confinement systems seeks to demonstrate the simultaneous attainment of temperature, density, and confinement time necessary for breakeven. Inertial confinement (laser or beam) systems, a newer technology, may lag behind magnetic systems in achieving breakeven power. Once a demonstration of breakeven is made, extensive engineering efforts would be required to design a commercial system.

However, even without achievement of breakeven power, either fusion system may be able to produce usable energy as part of a hybrid fusion-fission cycle. The fusion process produces neutrons which might breed fuel for light-water nuclear reactors more easily than it produces electricity.

The revised budget submitted by the Administration last February provides for continued work on fusion on an orderly basis.

RESEARCH, DEVELOPMENT, AND DEMONSTRATION

An effective Federal research, development, and demonstration (RD&D) program is indispensable for the production of new energy sources. Research is not an end in itself. The purpose of RD&D is to produce technologies for practical use. The final stage of a successful RD&D program is commercialization, the movement of a functioning technology into the marketplace.

The groundwork for eventual commercialization should generally be laid during the RD&D stage. Before embarking on costly research projects, the Government should have the best possible information on prospects for economic success and institutional acceptance. As scientific and technical advances are made, economic and institutional barriers to commercialization should also be addressed, so that if technical success is achieved in the RD&D program, commercialization can take place rapidly.

However, Government support of scientific research and engineering development does not constitute a commitment to subsequent demonstrations of technologies that do not meet technical, economic, national security, health, safety, and environmental criteria. The Government should support multiple parallel technological options in their early stages, but it should not drift unwittingly into a long-term guarantee of support for all options initially pursued. Only those technologies that satisfy criteria for practical success should be supported into the demonstration stage. Recognition that early Government support should not be regarded as a blank check for the future should benefit the entire RD&D program.

Commercialization activities, and in particular commercial demonstration projects, also must not become a hidden subsidy of technically feasible but economically uncompetitive technologies. Where subsidies are justified, they should be awarded in an open process that is responsive to national priorities.

A balanced RD&D program should have near-term as well as long-term benefits, should promote conservation and nonconventional resources as well as conventional resources, should support small-scale as well as large-scale projects, and should enlist the talents of individual inventors and small business as well as major corporations. In its revisions of the fiscal year 1978 budget, the Administration began the process of reorienting RD&D priorities to meet the country's real needs. The Administration proposed additional funding for the following items:

- programs to develop improved methods of energy conservation;
- solar heating and cooling demonstrations, mainly in residential buildings;
- application of solar energy in agricultural and industrial processes, including more than 60 agricultural projects in more than 30 States;
- development of improved ways to use agricultural and forestry residues, water-based energy crops, and animal wastes; and
- development and demonstration of the use of solar and wind energy to operate irrigation pumps and for other rural applications.

In accordance with the priorities set forth in the National Energy Plan, additional funds will be provided for research and development projects for conservation and small-scale energy systems. A new Office of Small-Scale Technologies is also proposed, in order to tap more fully the potential of individual inventors and small business firms.

Additional conservation projects are proposed. The Energy Research and Development Administration will conduct a feasibility study of waste heat recovery and district heating at several of its own facilities. To conserve natural gas, the Government will also fund programs for additional work on gas-fired heat pumps and small fuel cells for residential and commercial heating and cooling.

Other programs may add significantly to the nation's near-term natural gas supply. The Government will provide additional funding to accelerate the investigation of methane recovery from the geopressurized zones along the Gulf Coast and gas from Eastern Devonian shale.

The Government will add several initiatives to its research program to support the Plan's emphasis on increased use of coal, as described in Chapter VI.

The Government will provide increased funding for solar cooling and allied solar technology and for small wind energy conversion systems. It will also support a project to demonstrate the use of wood-derived biomass as a substitute for fuel oil. These projects could yield significant regional benefits.

New initiatives are proposed for geothermal energy. Additional funding will be provided to identify new liquid-dominated hydrothermal fields which could be tapped for direct thermal use. The Government will also support field experiments of direct, nonelectric uses of geothermal energy for residential space conditioning and industrial and agricultural process heat in areas where this resource has not previously been exploited.

The Plan's additional research and development program focuses on projects with near-term and mid-term potential. It emphasizes small, dispersed, and environmentally sound production and use of energy, particularly renewable energy. It also seeks to redress the advantage enjoyed by big business in the Government's current research and development program.

Chapter VIII.—The National Energy Plan: The Role of Government and the American Public

Government at all levels has a critical role to play in guiding the course of energy production and use. In addition to proposing specific initiatives, the Federal Government should:

- establish clear national energy goals;
- organize itself to administer national energy policy effectively;
- create a comprehensive, reliable repository of energy information;
- ensure competition in the energy industries generally and among the major oil and natural gas companies in particular;
- and
- provide assistance to low-income people during energy emergencies.

State and local governments will be asked to assume major responsibilities in cooperation with the Federal Government. Nongovernmental organizations and individuals can also make significant contributions to the success of energy policies. The private sector will continue its primary role as the major producer and consumer of energy resources.

NATIONAL ENERGY GOALS

There is no quick or easy solution to the energy problem. The re-orientation of American society to the newly recognized energy realities will occur only as a result of a multitude of measures over many years. An important part of the Plan is Congressional adoption of specific national energy goals, so that progress can be monitored and assessed. The proposed goals, to be achieved between now and 1985, are:

- reduce the rate of growth of energy consumption to below 2 percent per year;
- reduce gasoline consumption by 10 percent below the 1976 level;
- reduce oil imports to less than 6 million barrels per day, about one-eighth of total energy consumption;
- establish a Strategic Petroleum Reserve of 1 billion barrels;

- increase coal production by about two-thirds, to more than 1 billion tons annually;
- insulate 90 percent of American homes and all new buildings; and
- use solar energy in more than 2½ million homes.

The Plan does not seek illusory goals, such as energy independence. Rather, it seeks goals that are ambitious, but that are achievable in light of the present widespread waste of energy, and the large potential for conversion from oil and natural gas to coal. However, the proposed conservation goals do not reflect merely what can be achieved by the measures formally proposed in the Plan. These goals are set at more demanding levels in order to take account of voluntary actions outside the scope of the specific measures in the Plan, such as keeping buildings at 78° in the summer and 65° in the winter, carpooling instead of driving alone, and spending leisure time in ways that consume less energy. The goals challenge the American people to go beyond the Plan through voluntary actions.

If the proposed goals are adopted, then, beginning 2 years after enactment of the National Energy Plan, the President will submit to the Congress biannually a report on the nation's progress in moving toward the 1985 goals. The report will recommend any changes in the existing Plan, or any additional measures needed to meet the 1985 goals.

THE DEPARTMENT OF ENERGY

The initiatives presented in the National Energy Plan underscore the importance of creating at the earliest possible date a Department of Energy. Legislation to create this Department has been sent to the Congress by the Administration, and hearings have been held in both the House and Senate.

Although organizational changes alone will not solve any energy problem, creation of the Department of Energy is a necessity if the elements of the Plan are to be carried out in a coherent and effective manner. The Plan proposes a unified policy. The Department would carry out this policy through a unified organization that would coordinate and manage energy conservation, supply development, information collection and analysis, energy regulation, and research, development, and demonstration. Only through creation of a Department that combines the skills and expertise now dispersed through numerous Federal agencies will the Government obtain the compre-

hensive overview of interrelated energy problems and the organizational coherence needed to implement the National Energy Plan.

By consolidating more than 100 important energy data collection programs in the Federal Government, the Department of Energy would provide comprehensive and reliable energy information. An Energy Information Administration within the Department would organize and analyze information so that it could be used by governments, industry, and the public.

In addition, the ability of the Federal Government to administer the regulatory process when market forces do not suffice would be significantly enhanced by unification of most of the responsibilities for economic regulation of energy. The Department of Energy, operating within congressional mandates, would be able to avoid the inconsistencies and uncertainties inherent in a situation where agencies operate in isolation and sometimes at cross-purposes.

The Department of Energy would enable the Federal Government to coordinate its research, development, and commercialization activities within a policy-planning process that takes full account of the importance of conservation and near-term resource development. The Department would be the most effective means for ensuring that the priorities established in the National Energy Plan are translated into the Government's ongoing research, development, and commercialization efforts.

Finally, by combining the conservation programs of various agencies, the Department would be in a position to ensure that the strong emphasis of the Plan on fostering genuine conservation and improved energy efficiency will not be frustrated by a mass of competing, conflicting, and overlapping jurisdictions in the Executive Branch.

INFORMATION

The Federal Government needs more detailed and reliable information on energy matters than is now available. Much of the nation's remaining reserves of oil and natural gas are located on Federal lands and belong to the American people. More information is needed on the size of particular reserves and the rates at which they are being depleted. To identify and assess possible anticompetitive behavior on the part of major oil companies, the Government needs detailed data on their operations. To deal swiftly and effectively with energy emergencies, such as an interruption of foreign oil supply or a natural gas shortage, governments need information on local energy supplies and consumption patterns.

Accordingly, a three-part energy information program is proposed. It would include a Petroleum Production and Reserve Information System, a Petroleum Company Financial Data System, and an Emergency Management Information System.

For the Petroleum Production and Reserve Information System, the Federal Government would assume the data collection responsibilities now performed by the American Gas Association and the American Petroleum Institute. The oil and gas industries would be required to open their reserve estimation processes to Federal officials, who would supervise the collection and preparation of reserve data. Information collected and submitted to the Federal Government through these processes would be verified and randomly audited at the company level. Existing law regarding the protection of confidential proprietary information would not be changed.

The Petroleum Company Financial Data System would require all large companies, and a sample of small firms, engaged in the oil or gas business to submit detailed financial information to the Federal Government. Companies would have to conform to specified accounting principles and to report capital expenditures and operating results by geographical region and type of fuel. They would be required to submit information relating to functional areas, including refining, production, marketing and distribution, and information relating to foreign as well as domestic operations.

This comprehensive reporting program would enable the Government to assess the performance of the industry and individual firms, by providing a system of vertical accountability of the operations of integrated oil companies. The reporting program would restore confidence within the Congress and among the American people that the Government, not the oil industry, is in charge of national energy policy.

The Emergency Management Information System would provide governments with up-to-date information on local energy supplies and consumption. Such information is needed to respond if there should be an interruption of foreign oil supply, a natural gas shortage, or other energy emergencies. State energy offices, assisted by the Federal Government, would collect and maintain the data. As further preparation for possible electrical power shortages in the West this coming summer and natural gas shortages in future winters, the Administration is formulating contingency plans for submission to the Congress under the Energy Policy and Conservation Act.

COMPETITION

Promotion of competition is a critical component of public policy. Since energy is an essential commodity for all Americans, effective

competition within the energy industries is a matter of vital concern. Continuous vigilance is needed to ensure that the structure, behavior, and performance of the energy industries are vigorously competitive.

The Federal Trade Commission and the Antitrust Division of the Department of Justice will continue active programs of enforcement of the antitrust laws in the energy industries. Moreover, the promotion and maintenance of competition would be a major objective of the proposed Department of Energy, and would be the responsibility of a high-ranking official with appropriate staff support.

A prime responsibility of the Under Secretary for policy and evaluation would be to make certain that policies and programs of the Department promote competition. In particular, the Under Secretary would monitor resource leasing policies and rules, and research, development, demonstration, and commercialization programs to ensure that they are carried out in accordance with the purposes of the anti-trust laws.

The Under Secretary would also direct an active program to monitor the structure, behavior, and performance of the energy industries. The conduct of individual firms, prices, profits, concentration ratios, and similar matters would be closely reviewed; and any indication of a lessening of competition would elicit a prompt response.

In recent years, trends and practices in the energy industries have created substantial public concern. Attention has focused particularly on the oil and natural gas industries, with special reference to vertical and horizontal integration, as well as joint ventures and the international activities of the major multinational firms.

Public policy toward vertically integrated firms, those that span exploration, production, refining, and marketing of petroleum products, has long been a matter of dispute. The Federal Trade Commission is currently litigating a vertical integration case that addresses some of the relevant legal issues. In recent years, concern about vertical integration has increased due to the possibility that Federal oil price regulations have not held down ultimate prices to consumers, but instead have led to abnormally high profits for refiners. Further investigation is needed to determine whether in fact vertically integrated firms have manipulated profit margins of their various operations in order to circumvent regulations or to exercise market power for anti-competitive purposes.

Horizontal diversification by oil and gas producers, particularly into the coal and uranium industries, has led to concern that the major firms will be able to restrict the development of alternative energy sources. The potential exercise of such power could be detrimental as the nation increases its reliance on coal, uranium, and renewable energy sources.

Traditionally, the structure of the coal industry has been extremely competitive. It is still relatively unconcentrated compared to industries such as steel and automobiles. Nevertheless, recent trends have caused legitimate concern. A total of 32 oil and gas companies accounted for 16 percent of total U.S. coal production in 1974, a 48 percent increase over their share in 1967. These companies accounted for more than 18 percent of coal shipped to electric utilities in 1974, a 27 percent increase over their share in 1967. In 1974, they held 5 percent of total U.S. coal resources, compared to 1 percent in 1967. These figures do not indicate that the oil and gas companies have a dominant position or even significant market power in the coal industry. But the trend of oil and gas company entry into coal mining and the companies' activities and performance merit continuous attention to make sure that a competitive industry does not become noncompetitive.

At this time it does not appear necessary to proceed with new legislation mandating either vertical or horizontal divestiture in order to promote or maintain competition in the energy industries. However, the performance of the energy industries will be closely monitored to make sure that prices are in line with costs and that costs are reasonable. Armed with an efficient organizational structure and new information-gathering programs, the Department of Energy would have an active analysis and evaluation program to study these matters in depth. The proposed Petroleum Company Financial Data System would provide needed vertical accountability for major energy companies. In particular, as the oil and gas companies receive additional incentives, this system would show whether the benefits are being passed through to the public or are being captured as excessive profits by firms with undue market power. If it should appear that there are anticompetitive problems in the energy industries that cannot be reached under current laws, new legislation would be proposed.

The uranium industry is another area of concern that will merit continued attention. Recent rapid increases in uranium prices have raised questions about competition in that industry. In addition, private litigation has produced information that suggests possible anticompetitive actions. Effective competition in the uranium industry must be a matter of high national priority.

The competitive structure of the energy industries depends significantly on the independent producers of oil, natural gas, coal, and solar energy equipment and on the independent refiners and marketers of petroleum products. The Administration supports legislation similar to the pending "dealer day in court" bill. The Department of Energy would seek to preserve the competitive viability of independents in all segments of the energy industries.

Finally, a problem has resulted from the Tax Reform Act of 1976, which changed the tax treatment of intangible drilling costs. Some independent oil and gas producers have lost a tax deduction for such expenses, while corporate producers continue to enjoy the deduction. The law has thus put those independent producers at a competitive disadvantage and has adversely affected their exploratory drilling. This anomaly should be removed as part of the President's program for extending oil and gas price controls. As part of that program, the Administration would urge that independent oil and gas producers receive the same tax treatment for intangible drilling costs that their corporate competitors receive. However, investors who finance oil and gas exploration in order to obtain a tax shelter for income earned in other occupations should not receive such a benefit.

STATE AND LOCAL GOVERNMENT PARTICIPATION

A National Energy Plan can be built only on a foundation of partnership and understanding among the Federal Government, the States, local governments, and the nation's Indian tribes, which regulate or own a substantial part of U.S. energy resources.

Many of the programs proposed in the Plan cannot succeed without the active cooperation of State and local governments. The assistance of State and local governments will also be needed to harmonize the varying interests of the different regions of the country, all of which are affected by national energy policy. State and local governments performed admirably during the recent natural gas shortage, and their role in energy matters should increase in the future.

The States will play a critical role in developing an adequate repository of information for energy decision-making. The States' role in the proposed Emergency Management Information System is particularly important. That system should be of great value to both the Federal Government and the States in dealing with energy shortages. The utility reform program is another instance where the State role is crucial.

The Federal Government is willing to do its part to assist States, localities, and Indian tribes in coping with new energy developments, principally from coal utilization, that will occur under the Plan. Large-scale development places heavy demands on local communities for schools, roads, sewage treatment facilities, and other municipal improvements. Without proper planning for such developments, small communities may be overwhelmed and may be unable to prevent serious social and environmental problems.

A variety of existing Federal programs can assist States, communities, and Indian tribes in coping with development of major energy producing installations. A review will be conducted of these programs, and the views of States, local governments, and Indian tribes will be sought. If it should appear that there are gaps in coverage, additional legislation will be proposed.

EMERGENCY ASSISTANCE FOR LOW-INCOME PERSONS

Government at all levels has the responsibility for protecting low-income citizens from the most severe effects of the energy crisis. The Plan contains several programs to carry out that responsibility.

The weatherization program, by insulating large numbers of low-income homes, would moderate the effect of rising fuel costs on low-income families. Proceeds from the crude oil equalization tax and the standby gasoline tax would be distributed in a progressive manner that benefits low-income people. Protection for low-income people from the long-term increase in energy prices lies in a reformed welfare system, on which the Administration is hard at work.

The remaining major problem is the possibility of future supply disruptions, such as the natural gas shortage last winter or another oil supply interruption. Such events could cause temporary, but sharp increases in basic energy costs in some regions, or to users of particular fuels. Such increases are particularly harmful to low-income people, who have little or no discretionary income with which to meet energy price rises. Present programs are deficient in meeting this need. Therefore, the Department of Health, Education, and Welfare will promptly complete a redesigned emergency assistance program for submission to the Congress.

PUBLIC PARTICIPATION

The general strategy of the National Energy Plan reflects the tenor of comments received from the public during the preparation of the Plan. As a general matter, members of the public who expressed views preferred voluntary to regulatory measures, though not uniformly so. The public placed strong emphasis on conservation, stockpiling of oil to reduce vulnerability, and development of solar energy and other renewable or essentially inexhaustible resources. A summary of the public participation in the development of the Plan appears in a separate report.

The announcement of the National Energy Plan marks only the beginning of the effort to deal with the energy problem comprehensively. As the Plan's legislative proposals are considered by the Congress and as its administrative proposals are implemented, they will

be the subject of extensive public comment. The Administration encourages broad national discussion of the Plan and its specific elements.

The President will meet periodically with the Governors to discuss actions that the States can take to deal with the energy problem. The Federal Government will also sponsor additional town meetings and other public events to encourage citizen comment on national energy policy. Private organizations are also encouraged to sponsor seminars and meetings to consider the energy problem and how to deal with it.

But public participation can go far beyond discussion. There is much that individual Americans can do to help the country solve the energy problem. American families can reduce energy waste and their own fuel bills by investing in insulation and other energy-saving home improvements, and by reducing their use of air-conditioners this coming summer. Individuals can use public transportation where it is available instead of automobiles, or, if they must drive, go in car pools or van pools and observe the 55-miles-per-hour speed limit. Schools can help young people understand the energy problem and develop the conservation ethic. Employers can make conservation a high priority in incentive awards and suggestion programs. Business can develop better processes and practices to use energy more efficiently.

In sum, meeting the nation's energy goals should be a great national cooperative effort that enlists the imagination and talents of all Americans. At home, on the road, at work, and elsewhere, all Americans can do their part to help solve the energy problem.

Chapter IX—The National Energy Plan and the Future

To be successful, the National Energy Plan must squarely address the energy crisis and propose actions consistent with the President's principles. The Plan seeks to:

- reduce U.S. dependence on oil imports and vulnerability to interruptions of foreign oil supply;
- lower the rate of growth of total U.S. energy demand and make the U.S. stock of capital goods more energy efficient;
- shift industrial and utility consumption of oil and natural gas to coal and other abundant resources;
- provide incentives for new oil and natural gas discoveries;
- advance the development of new energy sources for the long-term future.

The Plan should be assessed by comparing its results with the likely situation without it. The year 1985 has been selected for the purpose of comparison. The middle of the next decade now appears likely to be the critical time when world oil production will approach the limit of readily expandable capacity. At that time the United States should be prepared for the subsequent period of growing oil stringency.

In some instances, the results of the measures proposed in the Plan may not be sufficient to achieve the goals proposed in Chapter VIII. These goals are ambitious. Their achievement will require voluntary action in addition to the Plan's specific legislative and administrative measures. In some instances, mandatory measures would be considered if voluntary actions are insufficient. The energy savings projected to be achieved by specific proposals in the Plan should be regarded as a basic minimum. Achievement of the Plan's more ambitious goals could be materially aided by the accomplishments of a purposeful citizenry or, perhaps, by unforeseen developments, such as technological improvements in transportation or exploitation of new gas supplies.

Achievement of the goals and strategy of the National Energy Plan could demonstrate the benefits of indicative planning. If private decision-makers voluntarily act within the framework proposed in the Plan, the United States could achieve its energy and economic goals with relatively little direct Government regulation of economic activity.

THE IMPACT OF THE PLAN ON THE ENERGY CRISIS

The first test of the Plan is whether it would make a significant improvement in the trends in energy usage that have produced the energy crisis.

The projections of future impacts are based on certain assumptions about population and economic growth. The U.S. population is projected to increase from 216 million people today to 235 million by 1985. The projections are also based on the assumption that the President's economic goals will be achieved, and that, accordingly, the gross national product (GNP) will increase about 46 percent by 1985.

Without the Plan and without any other Government restraints, U.S. demand for oil could be as much as 25 million barrels per day in 1985. The model projects oil demand in 1985 to be 22.8 million barrels per day, if the automobile efficiency standards under present law are met and if higher gasoline prices since 1973-74 reduce driving. The Plan would reduce oil demand by 4.5 million barrels a day, 20 percent below the projected level of demand without the Plan. Industrial consumption of oil would be reduced from 7 million barrels per day to 4 million.

If U.S. demand for oil were 25 million barrels per day in 1985, oil imports could be as much as 16 million barrels per day. At the level of 22.8 million barrels per day of oil demand, oil imports would be about 12 million barrels per day. The Plan would reduce imports to 7 million barrels per day. Voluntary conservation could achieve a further reduction to the national goal of below 6 million barrels per day.

The Plan is projected to reallocate natural gas to high-priority uses and to stimulate additional domestic production, as shown in Figure IX-1. Total natural gas consumption in 1985 would be the equivalent of 9.4 million barrels of oil per day, with or without the Plan, but the distribution of gas among energy consumers would be altered. Under the Plan, the residential and commercial sector would consume the equivalent of 4.1 million barrels of oil per day instead of 3.8 million, and electric utilities would consume 0.5 million instead of 0.9 million. Total industrial consumption would stay the same, with some industrial shifts of gas use to coal, and some shifts from oil to gas within the total. The Plan would also stimulate additional domestic gas production equivalent to 600,000 barrels of oil per day.

As a result of the conservation initiatives, the United States would achieve an annual rate of growth of energy demand of less than 2 percent by 1985. With additional voluntary conservation efforts, energy demand could be reduced even further.

The Plan would increase the use of coal in 1985 by the equivalent of 2.4 million barrels of oil per day (200 million tons) above the

level without the Plan, and 6.5 million barrels per day (565 million tons) above the 1976 level. The effects of the Plan on consumption and supply are shown in Figures IX-1 and IX-2.

Significant progress would be made to prepare the country for the period of oil stringency beyond the mid-1980's. The rate of growth of total energy demand and oil imports would both be brought down to manageable levels. The projections of the effects of the conservation program imply that the U.S. capital stock would have become more energy efficient. The reductions in industrial and utility use of oil and natural gas, and the increase in the use of coal together would represent a very important shift from scarce to abundant resources.

Figure IX-1

Fuel Balances by Sector

[Millions of barrels of oil equivalent per day]

	1976	1985 without Plan	1985 with Plan	1985 Plan plus additional conservation
Demand.....	37.0	48.3	46.4	45.2
Residential and commercial:				
Oil.....	3.5	3.2	2.7	
Natural gas.....	3.9	3.8	4.1	
Electricity.....	6.3	9.1	8.4	
Coal.....	.1	(1)	(1)	
Total ²	13.8	16.1	15.2	
Industry:				
Oil.....	3.2	7.0	4.0	
Natural gas.....	4.4	4.5	4.5	
Electricity.....	4.2	7.2	7.1	
Coal.....	1.9	2.7	5.0	
Total ²	13.7	21.4	20.6	
Transportation:				
Oil.....	9.2	10.6	10.2	
Natural gas.....	.3	.2	.3	
Total ²	9.5	10.8	10.5	
Electricity: ³				
Oil.....	1.6	2.0	1.3	
Natural gas.....	1.5	.9	.5	
Coal.....	4.9	8.2	8.3	
Nuclear.....	1.0	3.6	3.8	
Other.....	1.5	1.6	1.6	
Total ²	10.5	16.3	15.5	

See footnotes at end of table.

Figure IX-1—Continued
 Fuel Balances by Sector
 [Millions of barrels of oil equivalent per day]

	1976	1985 without Plan	1985 with Plan	1985 Plan plus additional conservation
Supply.....	37.0	48.5	46.4	45.2
Domestic:				
Crude oil ⁴	9.7	10.4	10.6	
Natural gas.....	9.5	8.2	8.8	
Coal.....	7.9	12.2	14.5	
Nuclear.....	1.0	3.7	3.8	
Other.....	1.5	1.7	1.7	
Refinery gain.....	.4	.9	.6	
Total ²	30.0	37.1	40.0	
Imports/exports (—):				
Oil.....	7.3	11.5	7.0	5.8
Natural gas.....	.5	1.2	.6	
Coal.....	— .8	— 1.2	— 1.2	
Total ²	7.0	11.5	6.4	5.2

¹ Less than 0.05 million barrels of oil equivalent per day.

² Detail may not add due to rounding.

³ Included in previous sectoral totals.

⁴ Includes natural gas liquids.

Figure IX-2
 Balances by Fuel ¹
 [Millions of barrels of oil equivalent per day]

	1976	1985 without Plan	1985 with Plan	1985 Plan plus additional conservation
Oil:				
Consumption.....	17.4	22.8 ²	18.2	17.0
Domestic supply ³	9.7	10.4	10.6	10.6
Refinery gain.....	.4	.9	.6	.6
Imports.....	7.3	11.5	7.0	5.8
Natural gas:				
Consumption.....	10.0	9.4	9.4	
Domestic supply.....	9.5	8.2	8.8	
Imports.....	.5	1.2	.6	
Coal:				
Consumption.....	6.8	10.9	13.3	
Domestic supply.....	7.9	12.2	14.5	
Exports.....	.8	1.2	1.2	

¹ Detail may not add up to total due to rounding.

² Assuming compliance with automobile efficiency standards under current law, and reduced driving as a result of higher gasoline prices. Without these assumptions, consumption would be 25 million barrels per day.

³ Includes natural gas liquids.

The reduction of oil imports, together with the expansion of the Strategic Petroleum Reserve, the diversification of U.S. sources of foreign oil supply, and the development of contingency plans would significantly reduce U.S. vulnerability to a supply interruption.

Finally, implementation of the Plan would enable the United States to make a contribution to the maintenance of economic progress and political stability throughout the world. By reducing its own demand for world oil, the United States would help reduce the economic dislocations and political tensions that would result from an intense scramble for diminishing world supplies of oil.

THE ECONOMIC CONSEQUENCES OF THE PLAN

The macroeconomic impacts of the Plan would be quite small in a \$2 trillion economy. In view of the range of uncertainty surrounding any econometric projection across a period of 8 years, the following projections should be regarded as merely indicative of the direction of the consequences of the Plan, rather than as precise forecasts.

Various macroeconomic analyses have been examined. From these analyses it appears that the program would not have a negative economic impact. Some analyses indicate the Plan could be slightly stimulative. The effects on employment are consistent with the impact on GNP. The standby gasoline tax, if triggered, would have a slightly dampening effect compared to base conditions.

Inflation would increase on the order of one-quarter to one-half a percent per year over the next 4 years. The smaller number would occur if the standby gasoline tax were not triggered, and the larger number would be more likely if the gasoline tax were in effect.

It is important to emphasize that with or without the Plan, the price of fuels will rise. The Plan would increase the price of fuels somewhat. However, the conservation program would moderate the impact on energy bills and might even offset the increases.

The program is designed to stimulate capital investment in conservation and coal conversion. Between now and 1985, coal conversion would require an additional capital investment of more than \$45 billion beyond what would otherwise be required. Four billion dollars of additional capital investment would be required for coal mining. The Plan could reduce new capacity requirements for electric utilities by as much as \$40 billion. Thus, the net additional investment required for coal conversion and for new electrical generation capacity could be reduced.

A substantial part of the investment generated by the Plan would go to make homes energy efficient. Estimating the capital cost of that

effort is exceedingly difficult. However, the total additional investment probably would be around \$20 billion.

The effect of the Plan on domestic automobile sales would be small, but probably positive. However, due to the large uncertainties involved, it is extremely difficult to predict the exact level of new car sales. If the standby gasoline tax were triggered, sales would be slightly lower compared to base conditions.

It should be emphasized once again that all of these projections are subject to a substantial range of uncertainty. They suggest that the National Energy Plan would not adversely affect economic growth. There would be a moderate increase in the rate of inflation. But this disadvantage is outweighed by the impacts on energy use. The future availability of energy has significant economic implications that are not captured by current projections of the GNP or other economic indicators. Standard projections implicitly assume energy will continue to be available at reasonable prices. If it were not available at reasonable prices, all economic activity would be severely affected. An assessment of the economic consequences of the National Energy Plan cannot be made without taking into account the benefit of adequate supplies of energy to maintain the very health of the economy. The economic and social advantages of solving the energy problem are obvious.

THE IMPACT OF THE PLAN ON CITIZENS AND THE ENVIRONMENT

The Plan is based on the principle of equity. Revenues from the crude oil equalization tax would be returned to the economy progressively, as would any revenues from the standby gasoline tax. Although the major price, tax, and regulatory burdens would fall on industry rather than on individuals, those economic burdens would be reflected in higher priced goods and services.

Although energy costs would be generally higher, consumers would receive specific benefits from the Plan. The residential energy conservation program would be available for all households to help reduce energy waste and moderate high energy costs. Residential consumers of natural gas would have more assured supplies, would be protected from the cost of higher priced new gas, and would benefit from the gas utility reform program. Residential consumers of fuel oil would receive an additional share of the equalization tax proceeds as a reduction in price when they buy fuel oil. All users of electricity would benefit from reductions in new capacity construction brought about by conservation, and residential users would also benefit from the

electric utility reform program, which would result in improved utility load curves and, therefore, lower costs. All consumers would also receive, through energy payments from the equalization tax revenues, the bulk of the surpluses generated in bringing oil prices up to the true replacement cost.

American workers would benefit from more assured supplies of energy and a reduced risk of factories shutting down for lack of fuel. There would also be less incentive for industrial firms to move from one part of the country to another in search of reliable fuel supplies. The Plan would also create jobs directly through specific programs such as residential energy conservation, and might have positive indirect effects, as well.

The special needs of the poor and the elderly are addressed. Expansion of the existing Federal weatherization program would particularly benefit the poor and the elderly. The existing HEW Federal-State emergency assistance program would be revised to meet energy emergencies. The progressive nature of the energy payment system is also a benefit. The long-term needs of the poor and the elderly for protection from rising energy prices will be met through a reformed welfare system.

Small firms in the energy industries would benefit from the Plan's emphasis on competition and from the reorientation of the Federal Government's research, development and demonstration programs. Commercial establishments that consume natural gas would benefit from the Plan's pricing proposals.

Businesses would benefit from creation of a single market for natural gas instead of the segmented market that has resulted in the anomaly of plentiful but high priced gas in the intrastate market and cheap but scarce gas in the interstate market. Energy prices would be sufficient to elicit a flow of capital for investment in the energy industries. Investment decisions throughout the business sector would be facilitated by stability and predictability in pricing, environmental and other policies. A healthy business climate for the long run can be preserved only through an effective response to the energy crisis.

Many of the proposed measures would help preserve the quality of the environment. The conservation measures, the support for stringent environmental standards, the emphasis on solar energy and improved technologies for the use of coal, and the measures to increase the safety of light-water reactors are all positive steps.

Implementation of the conservation program clearly is the most important action that could be taken to protect environmental quality

while allowing for continued economic growth. The quality of the nation's air would be preserved despite increasing use of coal. The development of solar energy systems would have a modest short-term impact, but over the long run should make a valuable contribution. The proposed steps for siting criteria for nuclear plants, plant inspectors, and waste management, would make important contributions to nuclear safety and safeguards.

Despite the strong environmental measures discussed in the Plan, some uncertainty will continue over the impacts of increasing coal utilization. The President will appoint a special committee to study the health effects of increased coal production and use. In addition, the Government's coal research and development program will be expanded. The program will focus on meeting environmental requirements more effectively and economically.

THE FUTURE BEYOND 1985

The period from 1985 to the end of the century will test the success of the National Energy Plan. If oil importing countries have failed to restrain their demand by the time world oil production levels off, prices are likely to skyrocket and critical shortages are likely to develop. Reduction in the rate of growth of energy demand, combined with additional domestic energy production, should enable the United States to make the energy transition successfully without major dislocations.

More than two-thirds of the additional private investment required to carry out the Plan is projected to be made before 1985, but many of the benefits, particularly of the conservation programs, are much larger after 1985.

Steps taken during the next few years should produce much greater efficiency in vehicles, buildings, and factories. It is realistic to envision a period of growth for the U.S. economy for the remainder of this century, together with a steady reduction in the amount of energy required to drive a car, heat a home, or run a factory. The lower birth rate of recent decades will also reduce energy requirements after 1985. Fewer Americans will be entering the family-forming age group, which creates the largest demand for housing, automobiles, and energy intensive appliances.

If the National Energy Plan is adopted promptly, the nation's energy requirements per dollar of GNP will steadily decline. The United States will have the time it needs to develop sources of supply to build a more reliable energy base for continued economic growth in the 21st century. Growth rates in energy consumption during the 1985 to 2000 period will be significantly below those projected up to 1985.

The present and future markets for energy can be divided roughly into three categories. The first is transportation, which now is wholly dependent on petroleum. The second is high quality, high temperature energy such as electricity or high temperature steam, which is used for most industrial processes and such household needs as lighting and appliances. The sources of high quality energy currently are fossil fuels and nuclear power. Solar electric technologies and certain geothermal resources can also produce high quality energy. The third category is low-grade heat—temperatures below the boiling point of water—which can be used to heat and cool buildings and provide about one-third of the process heat for industry.

Roughly two-thirds of energy consumption requires petroleum or other high-quality energy in the form of fossil fuels or electricity. It is the low-quality energy requirements that could substantially be met by decentralized solar heating and cooling systems, waste heat from power plants, direct use of geothermal energy, or other diffused and less concentrated energy sources. Over the long run, it is wasteful to use high-grade energy sources, such as fossil fuels and electricity, for end-uses that can be satisfied by low-grade heat.

The strategy of the Plan beyond 1985 is twofold. First, it seeks to encourage dispersed solar energy systems, waste heat, and, within geographical limits, direct use of geothermal energy for those uses for which such low temperature energy is adequate. These uses constitute roughly one-third of the total energy market. Second, the Plan seeks to promote the economical, environmentally sound use of various forms of coal, supplemented by nuclear power, for the high temperature needs of powerplants and industry. A variety of other energy sources—solar electric, biomass, municipal solid waste, high temperature geothermal resources and others—would be developed to supplement coal and nuclear power as sources of high grade industrial heat and electricity.

It is possible that by 1985 a significant share of new buildings in the United States will be incorporating solar technology as the primary source of energy for water and space heating and perhaps cooling. Solar energy can also supply some of the low grade process heat needed by industry and agriculture. Geothermal energy, a virtually untapped but potentially large resource, could meet many direct thermal needs in areas near geothermal resources. Both resources could also, during the 1990's, supplement the light-water reactor and coal for generating electricity.

Some very important questions currently remain unanswered. It is not yet clear what energy source will replace petroleum in transportation. Coal can be converted to petroleum products, as Germany demonstrated during World War II, but current synthetics are extraordinarily expensive, more than double the world price of oil. Perhaps electric cars, buses, and trains will be part of a long-term solution for

reducing oil consumption. Methanol, an alcohol even now sometimes used for fuel, could also make a major contribution as a substitute or additive to gasoline. New opportunities no one can foresee may appear during the next two decades. The United States will need to pursue research and development on all promising options to determine whether any of them can fill the petroleum gap.

Another major question for the future is the long-term source of electric power. The year 2000 is a short period away in terms of the time required to develop new sources of energy. Nuclear energy was discovered 38 years ago, but today provides only about 3 percent of total U.S. energy. Experience with nuclear energy teaches that the development of a new energy source is not simply a matter of solving technical problems. Assessment of an energy system from the perspectives of health and safety, economics and environmental quality must also be an integral part of any research and development program.

Under the Plan, the Federal Government will pursue a diversified effort to develop new sources that can meet electricity generating needs beyond the turn of the century. The major options include the nuclear breeder technologies, nuclear fusion, centralized solar energy and hot dry rock geothermal resources.

Many countries are developing breeder technologies. These technologies could be made commercial by the end of the century. However, the proliferation risk from a plutonium economy and the availability of energy alternatives make it advisable to defer further development of the plutonium breeder technology. Alternative breeder technologies that do not raise the same proliferation concerns are in the very early stages of development. A diversified breeder research effort should be continued as an option for future energy supply, providing insurance if other alternatives fail.

Fusion power remains an enigma. If proven feasible, it could provide a virtually limitless source of energy. Its scientific feasibility, however, has yet to be established despite years of intensive research, and it may bring environmental problems of its own, which have yet to be evaluated. Fusion research should be pursued in a deliberate and careful manner. The United States cannot now count on fusion power to meet energy needs.

Solar energy is also a possible source of electrical energy for the future. The options available are to generate electricity through photovoltaic systems, power plants in the desert, ocean thermal gradients, biomass or perhaps even space satellites. The economics of all these options are poor at this early stage of development. Solar electric technologies also present various environmental problems that require evaluation.

The current economics of solar electric systems do not doom them for the future. The research and development effort has hardly begun, and the costs of alternative sources of electrical power are rising. Moreover,

conventional economics do not reflect solar's major advantages—the absence of the problems of proliferation and safety inherent in most of the nuclear technologies. Even so, it must be recognized that solar electric—as distinguished from decentralized solar—is still an unproved technology. It, too, is not yet an option on which society can rely.

Finally, hot dry rock geothermal resources may provide substantial quantities of high grade energy during the next century. Hot dry rocks deep in the earth contain vast quantities of heat, but no fluid with which to bring the heat to the surface. Before this resource can be tapped, difficult engineering problems will have to be solved.

In sum, the long-term future of electrical energy in America is still open. It is critical that the United States develop a broad range of non-conventional technologies to assure that in the future it will have energy options that are reasonably priced and environmentally acceptable.

CONCLUSION

Implementation of the National Energy Plan would enable the United States to achieve the President's goals in a manner consistent with his 10 principles. The United States would reduce its short-term vulnerability to a supply interruption by reducing oil consumption and imports, by expanding the Strategic Petroleum Reserve, and by proceeding with diversification of foreign oil supplies and the development of contingency plans. Through effective conservation programs, the United States would upgrade the efficiency of its stock of capital goods so that it could weather the period when world oil production approaches its capacity limitation. Thereby, the United States would avoid sudden and possibly severe interruptions in the flow of goods and services resulting from shortages of energy. By proceeding with research, development and, when appropriate, early commercialization of renewable energy sources, the Plan would do much to prepare for the time when oil and gas will be virtually unavailable for energy use and alternative energy sources will be needed.

The effort to achieve the major objectives of the Plan would provide a sense of mission to the American people. Previous generations of Americans have faced major challenges—settling the frontier, industrialization, war, depression. This generation is discovering that it faces a challenge that is equally great—the energy crisis. Meeting this challenge will require sacrifice, hard work, skill and imagination on the part of the American people. It will require a new national ethic that values energy efficiency and condemns energy waste. And it will require a degree of cooperation that the United States has attained only in meeting the great challenges of the past. As the President stressed in his address on April 18, 1977, "This difficult effort will be 'the moral equivalent of war'—except that we will be uniting our efforts to build and not to destroy." The prospect of America organizing to meet the energy crisis is not grim. It is exciting.