Incentives to Stimulate Solar Energy Use—A Proceedings of the Second Seattle Workshop

June 1981

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INCENTIVES TO STIMULATE SOLAR ENERGY USE-
A PROCEEDINGS OF THE SECOND SEATTLE
WORKSHOP

September 2-5, 1980
Seattle, Washington

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PREFACE

On September 2-5, a workshop on Incentives to Stimulate Solar Energy Use was held at the Battelle Seattle Research Center with sponsorship of the Department of Energy. This workshop grew out of a series of studies performed by Battelle Pacific Northwest Laboratories identifying federal incentives provided to six other sources: nuclear, hydro, coal, oil, natural gas, and electricity and analyzing the results of those incentives. A copy of the study reports "An Analysis of Federal Incentives Used to Stimulate Energy Production, Rev. II" and "An Analysis of the Results of Federal Incentives Used to Stimulate Energy Production" was sent to participants in advance of the workshop. The principal goal of the workshop was to consider how best to apply federal incentives to solar energy, based on experience with incentives for other energy sources.

The workshop was divided into four sessions. In the first session each participant was given an opportunity to present a brief talk on application of a specific incentive in his or her area of specialty to some element of the renewable resource industry. These papers are part of the proceedings of the workshop.

The second session of the workshop was divided into groups built around types of incentives; i.e., creation or prohibition of organizations, taxation, collection of fees, disbursements, requirements, traditional government services, nontraditional government services, and market activity.

In the third session of the workshop groups focused on market sectors, i.e., residential, commercial, industrial, agriculture, and transportation. The purpose of this session was to determine how incentives used in each market might be applied to solar energy.

During the fourth and final session of the workshop the participants assembled as a group to review conclusions and insights applicable to the formulation of incentives for solar energy.

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CHAPTER I

INTRODUCTION

I. INTRODUCTION

GREETINGS FROM THE BATTELLE TEAM

Roland J. Cole and Bruce W. Cone

We want to welcome you all to the Pacific Northwest, to Seattle and our typical Northwest weather, and the Battelle Seattle Research Center. Thanks to all of you who came either long distances or at awkward times to make this inspite of restrictions on travel times and so forth. I also would like to pay a little tribute to the human mind that can schedule not one, but two national solar conferences in what may be the least sunny city in the U.S.

This is, for us, a very special group. As we proceed through the workshop you'll see how special. Four years ago many of us in this room started on a journey together. In the past four years, there have been many inputs. The initial contribution of the Battelle team was the study which estimated that \$127 billion had been spent on incentives to traditional energy sources. That hit the streets about the time of the Domestic Policy Review, which then formulated the 20% goal, now national policy. There have been meetings in Washington, D.C. There have been meetings at SERI in Golden, Colorado. There was the first Seattle workshop here about two years ago, contractors' reviews in Washington D.C., and meetings in Brussels, Belgium. Through it all, we have developed a collective body of thought that we think is shaping the development of solar policy in America. There is one man who is the driving force behind the development of this body of thought, Roger Bezdek.

WHERE WE HAVE BEEN

Roger Bezdek

Four years ago, Bruce and I first talked about solar policy and incentives and various ways of trying to advance the market for solar technology. In the history of this country, the recent history at least, what kind of policies, what kind of investments, and what kind of incentives have been granted to "conventional sources of energy". What I envisioned at the time was a project that would last a month or two where the Battelle Institute would look at the literature and give me a summary

report. As it turned out, and it still amazes me, very little, if anything, had been done up to that time in terms of what I would call a rigorous, scientific, quantitative analysis. From those early discussions has emerged a program which has lasted four years.

While I was at DOE, I very humbly referred to this work, this ongoing series of reports, as probably the most relevant and potentially important thing that DOE has funded since its existence. I think that my initial impression has been born out. What this project has done is to look over the last forty, fifty, sixty years, and identify and, more importantly, quantify what the United States Federal Government has done to encourage energy production and development by technology, by year, by type of incentives. I think the importance and potential significance of this work is difficult to overstate.

In the past several years we've seen the analysis and the data, widely used within domestic policy review. It surfaced in Congress. It has been widely cited in the literature. I think its importance will continue to grow in the future. Not only has this project looked at the costs of different types of incentives for energy production, but even more difficult, what the benefits or the results of these incentives to energy production have been.

Why is interest there? What significance does this kind of work have for energy policy? First of all, the obvious is that, for a whole variety of reasons, it's nice to know what this country has done for the past forty or fifty years to stimulate energy discovery, production, development and utilization. It's impossible to talk about policy in the future without knowing what has been done in the past.

I could spend easily the entire morning talking about the ramifications of what has come out of these studies. One of the things that strikes me is that a large portion of the monies spent by the Federal Government to encourage energy development, emerged from programs that had little or nothing to do with the stimulation of energy development. For example, somewhere between 15 and 20 billion dollars was expended to support development of hydro facilities emerging from programs that were originally formulated in the 1930s to put people back to work, to prevent

floods, provide recreation land, and reclaim land. The original idea behind legislation behind the proposals, behind the investment expenditures, was not to develop a new source of energy--hydro energy--but a whole variety of other purposes. I can go through each of the technologies, the whole variety of programs that were instituted for many purposes, very often the least of which dealt with energy. In trying to develop any kind of rational energy policy in the future, this must be kept in mind.

One criticism that is frequently leveled is that just because we spent \$100 billion on the oil depletion allowance does not justify spending \$100 billion on solar energy development over the next 20 years. It was never the purpose of this project to say that because we spent X billion dollars on oil or nuclear or gas that solar is justified, or that we are justified so many more billion dollars on solar or conservation or renewables. Take the case of sunk subsidies, costs and discounting present values and to try to estimate how much, in present dollar terms, solar energy sources and conservation are being discriminated against because the history of past subsidies. That's a whole different issue. It's much more complex. It is not simply a question of summing up a number and dividing by a number of years the number of technologies. It's really much more involved than that. That's another use of the numbers.

Another way to look at this analysis is to look at technologies or different types of programs, tax incentives, loan guarantees, and requirements and try to set up a strawman solar program for the next 20 years based on conventional energy sources. Look at a 20% goal and, given it is some sort of national consensus on where we want to get to from where we are, look at the physical as well as the fiscal requirement of achieving such a goal. Work it back year by year, by number of systems, and by average cost of systems. This is the kind of money we are going to have to expend. It is going to cost in the range of a trillion dollars if we are really serious achieving these schedules. On the basis of past energy policy and history, perhaps this is the way the money should be spent to achieve these stated national goals.

Before concluding, I would just like to mention that as part of this program, we've also looked at the energy policies of other industrialized nations. That's perhaps the subject of yet another three or four day conference. The analysis presents similarities, the differences, in terms of the way the different countries have chosen to develop energy policies, to stimulate energy production, exploration, development, and conservation. Again, many of the results are highly counterintuitive in terms of what we perceive. I think there are a lot of interesting insights that can be gained from this type of international comparison.

In brief, that's where we have been, or more correctly, how we have gotten to where we are today.

WHAT WE WANT TO GET DONE HERE

Bruce W. Cone

The purpose of the workshop is to create and record interaction among a heterogeneous group of identified contributors to energy policy. Toward this end, potential contributors were invited to represent a wide variety of professional skills and training in diverse academic disciplines. A copy of the research report An Analysis of the Results of Federal Incentives Used to Stimulate Energy Production accompanied each invitation. Potential contributors were asked to write short papers in direct response to some element of this report. This gives each participant a common theme as we discuss incentives to stimulate solar energy use.

The expected results of the workshop are:

- (1) To extend the synergistically-generated body of thought presented in the report beyond the initial team to a select group of potential collaborators in the development of solar energy policy.
- (2) To expand this body of thought to include ideas generated by participants prior to the workshop as well as those developed as a result of the interactive process created within the workshop.
- (3) To broaden the scope of the initial research through the interactive process of the workshop in order to guide further program direction.

- (4) To strengthen the base initiated with commencement of the analysis of federal incentives used to stimulate energy production in order to draft U.S. policy for the accelerated development of solar energy.

Toward attaining the expected results, the activities of the workshop were divided into four categories:

- (1) plenary sessions which allowed individuals to present papers focused on some aspect of the research report or extension of its use,
- (2) small group discussions which created a forum of interaction directed toward specific pre-formulated questions,
- (3) plenary sessions for the reporting of the response of each group, and
- (4) a round table discussion to aid in amalgamating individuals' thoughts into a set of workshop results.

The chronology of the workshop will first focused on the presentation of individual papers. Following these papers, the workshop will be divided into four groups, each to discuss one type of incentive as it fits into an overall solar incentive program. The groups will then reconvene with the reporters presenting the activities of each group to the entire workshop. Presentations of individual papers will continue tomorrow. Following these papers, the workshop will again be divided into three groups, each discussing specific end use sectors. The participants will reconvene to learn what the other groups discussed. The workshop concluded with a summary statement from each of the participants.

CHAPTER II

A REVIEW OF AN ANALYSIS OF THE RESULTS OF FEDERAL INCENTIVES USED TO STIMULATE ENERGY PRODUCTION

A REVIEW OF
AN ANALYSIS OF THE RESULTS OF FEDERAL
INCENTIVES USED TO STIMULATE ENERGY PRODUCTION

Paul Sommers, Alfred Marcus, Harold Harty, William Sheppard
David Lenerz, Roland Cole and Bruce Cone

The intent of this study was to enhance the formulation of a national incentive policy for renewable resource utilization by examining past incentives for traditional energy forms. The research summarized here builds on an earlier analysis which estimated that in the years between 1918 and 1977 the Federal Government expended \$217.4 billion (1977 dollars) for incentives to stimulate energy production. The energy types considered were nuclear, hydroelectricity, coal, oil, natural gas, and electricity. The present study shows that extra production induced by these incentives was at least 61 quadrillion Btu (quad). The research also estimated price changes and, in a nonquantitative manner, other effects.

AN ESTIMATE OF FEDERAL INCENTIVES

Federal incentives to stimulate energy production between 1918 and 1977 amounted to \$217 billion, representing 33 distinct incentives, divided into six incentive types, as shown in Table 1.

The six categories are defined as follows:

1. Taxation is the exemption or reduction of a tax that is otherwise levied. This was used for gas and oil in the form of a percentage depletion allowance and the expensing of intangible drilling costs. A percentage depletion allowance was also used for coal. Many electric power suppliers exempted revenues, used liberalized depreciation, sold tax-free bonds, and received investment tax credits.
2. Disbursements are actions in which the Federal Government gives out money without receiving anything directly or immediately in return. This category included oil tanker subsidies and liability insurance for nuclear reactors.

TABLE 1. The Cost of Incentives Used to Stimulate Energy Production, 1918-1977 (Billions of 1977 Dollars)

	<u>Nuclear</u>	<u>Hydro</u>	<u>Coal</u>	<u>Oil</u>	<u>Gas</u>	<u>Electricity</u>	<u>Total</u>
Taxation		1.8	4.0	50.4	16.0	31.4	103.6
Disbursements				1.1			1.1
Requirements	1.1	(a)	0.7	41.9	(a)		43.7
Traditional Services			2.3	6.0		0.5	8.8
Nontraditional	15.1		2.7	1.5	0.3		19.6
Market Activity	<u>1.8</u>	<u>13.5</u>	<u>(a)</u>	<u>0.4</u>	<u>0.1</u>	<u>24.7</u>	<u>40.6</u>
Totals	18.0	15.3	9.7	101.3	16.5	56.6	217.4

(a) Less than \$0.1 billion.

3. Requirements are demands made by government and backed by criminal and civil sanctions. These included federal energy price regulations, stripper well price incentives, and high yield on oil pipelines. The federal supervision of the natural gas industry and wellhead price controls was treated as requirements for the gas industry. Coal mines had to meet health and safety requirements. Private dams were regulated. Safety requirements for nuclear reactors were set by the Atomic Energy Commission and the Nuclear Regulatory Commission.
4. Traditional governmental services are activities provided when private ownership or operation is not practical within the current political system. The maintenance of ports and waterways for oil and coal and the activities of the Rural Electrification Administration (REA) constituted traditional services.

5. Nontraditional governmental services are defined as activities provided when private ownership or operation is possible but not thought to be in the general public welfare. This incentive consisted of research and development and the collection of data by the Geological Survey, Bureau of Mines, and Department of Energy.
6. Market activities consist of direct governmental involvement in one or more steps of production, exchange, or consumption. Oil, gas, and coal leases from the Bureau of Land Management, federal purchases of uranium, the construction and operation of enrichment plants, the construction and operation of dams, and REA loans were classified as market activities.

PURPOSE

The purpose of the analysis summarized here was to estimate the results of these 33 incentives in terms of their effects on energy price and quantity as well as on nonquantifiable values such as federal-state relations, competition, and capital formation. The findings are reported so that the dialog can continue to incorporate the lessons from past incentives to the production of energy from traditional sources into a federal renewable resource energy policy. They are reported as a budget to serve as a point of departure for future debate centering on the cost of specific federal actions over relatively short periods.

METHOD

There are five general methods of estimating the results of federal actions: mathematical modeling, analogy, inspection, engineering costs, and expert opinion. Models of the energy sector of the economy were found to be simplistic or too expensive to adapt and use. Analogy with other well-understood actions was not useful, because the cases under consideration were not sufficiently similar. Inspection, consisting of a comparison of energy production before and after the incentive, was used as a starting point. The engineering approach was used to calculate how changes in technology and the costs of specific inputs affected energy

prices and quantities. The opinions of experts knowledgeable about specific actions were sought through interviews, questionnaires, and analysis of public statements.

ANALYSIS BY INCENTIVE TYPE

A generic analysis focused on the results of the applicable incentives during 1976-77. The expert opinion approach was used, employing opinions of those active in the policy-making process. These came from interviews and public statements as recorded in contemporary newspaper accounts or congressional hearings.

Thirteen impact types were analyzed for each incentive type. These included energy produced per dollar, timing and predictability of response, ease and flexibility of administration, and dispersion and visibility of the results. Each incentive ranked high in some characteristics and low in others, giving credence to the importance of having a balance of incentives when designing a strategy. Each incentive type varied as much in its impacts as the incentive types varied from each other.

The following are some general findings about the incentives:

- o Disbursements produce relatively predictable results and are easy to control and terminate. They require technological skill to administer.
- o Tax incentives were found to produce relatively quick responses and were relatively easy to adopt and modify. They could affect a large number of people with low public visibility.
- o Market activities have a high energy impact per dollar. Predictability and speed of response for the government as a consumer are high. The government as a consumer is more easily administered than the government as a producer.
- o Services, both traditional and nontraditional, produce responses relatively slowly and have a low energy impact per dollar. They are easy to administer.

- o Requirements produce relatively quick responses and are relatively predictable. They are easy to initiate but difficult to administer.

If the government has confidence in a particular solar technology and wants quick response, it should provide tax incentives and buy that type of equipment. If the government wishes a high impact per dollar, it should both invest in the production of energy from solar resources and consume that form of energy. If it wants predictable outcomes, it should disburse funds, consume solar energy, and require the use of it. A highly visible solar program would result if the government entered into the production of energy from solar resources.

NUCLEAR ENERGY

To estimate the results of federal incentives to the nuclear industry, responses were analyzed from 48 persons involved in significant ways in the early development of nuclear power. Their opinions varied on the effectiveness of funding and types of incentives, but general agreement prevailed that there was substantial capability and willingness in industry to commercialize nuclear power with technology that had been developed by the mid-fifties even without incentives. Positive federal support in the form of legislation, general encouragement, and supportive attitudes was considered an important (and to some, sufficient) incentive to commercialize nuclear power. Indeed, about one-third of the responses indicated that the U.S. economic system provided the necessary incentives for industrial growth without being heavily dependent on federal incentives. Some responders commented on the importance of liability insurance and incentives to the uranium mining and milling industry. Some were quite outspoken that regulations have had an adverse effect on the numbers of nuclear plants built or planned, on foreign policy matters, and on a number of organizational and legal factors.

Through 1977, light-water reactors in the U.S. generated about 3.35 quad of energy. Based on the responses from the energy industry survey and supporting analyses, federal incentives were estimated to have increased nuclear energy production by slightly more than one quad. This

was achieved through the expenditure of about \$6.3 billion on light-water reactors. A total \$18 billion was spent on all nuclear activities.

Important to the development of nuclear power was a congressional constituency epitomized by the Joint Committee on Atomic Energy, which helped overcome legislative roadblocks to commercial development. This activity suggested that legislative requirements to facilitate solar adoption be identified early so that appropriate implementation actions can be instigated in a timely fashion. It was also noted that the Power Reactor Demonstration Program could serve as a model to accelerate the use of solar-electric generation by utilities.

HYDROELECTRICITY

The Federal Government manages 145 hydroelectric facilities that account for 51% of the net hydroelectric generation. Another 164 federally subsidized, municipal, state, and utility-district facilities produce an additional 24%. A total \$15.33 billion of incentives to hydroelectricity production was made available from 1933 to 1977.

It was estimated that market activities have resulted in the production of 12.86 quad since 1933, calculated from the fossil fuel equivalent of hydroelectricity. The price of power was reduced by 29.2¢ per million Btu. The \$1.77 billion exemption of federal power revenues from taxes is estimated to have decreased the price of hydroelectric power by 8.4¢ per million Btu.

Regional development resulted from controlling floodwaters, from providing year-round water supplies to agricultural and municipal users, from opening up inland navigational routes, as well as providing dependable, abundant, and affordable electrical energy. The largest impacts came in the form of increased capital formation, modification of public and private relations, demographic factors, increased employment and productivity, and definite changes in the quantity and price of hydroelectricity. More moderate impacts occurred for such factors as the competitive structure of the industry, the balance of payments, the regulatory burden, the quality of life, and sectoral changes.

The Federal Government could stimulate the centralized production of solar energy by creating incentives to locate sites where solar potential is highest. It could then set a high long-range return on investment and finance construction. To accelerate repayment, the revenues from such a facility could be tax free.

COAL

Federal incentives for coal amounted to about \$10 billion. It was estimated that the Mine Health and Safety Act of 1969 resulted in a 10¢ per million Btu increase in price and had a negative impact on productivity. The coal depletion allowance has had a negligible impact on coal output; yet without it the price of coal would have been approximately 1.3¢ per million Btu higher. Governmental construction, operation, and maintenance of ports and waterways helped lower the market price of coal by about 1/2¢ per million Btu while having a negligible impact on coal output. Governmental research and development activities, data gathering activities, and federal coal leasing policies have not yet had a significant impact on the price and output of coal.

The analysis of coal incentives led to the conclusion that for small, under-capitalized firms an investment tax credit that pays cash if there is no tax liability has a greater impact than accelerated depreciation. This happens because these firms in their early years have large investments to make and little taxable earnings to be offset by depreciation. Research and development sponsored by the government can help firms too small to do the work for themselves or can help the industry as a whole in cases where a private developer cannot get sufficient competitive advantage from innovation to justify the effort.

OIL

Federal incentives to stimulate oil production have amounted to over \$100 billion. It was estimated that 26.6 quad of increased production resulted from the expensing of intangible drilling costs and the percentage depletion allowance. These taxation incentives held the price of oil down by 21.3¢ per million Btu. Stripper well and new oil pricing

allowances accounted for almost \$42 billion of the incentives and stimulated approximately 2.3 quad of increased production. The higher price for new oil and stripper well oil did, however, cause refiner acquisition costs to increase by approximately 11.6¢ per million Btu.

Oil transportation incentives, data gathering, federal leasing policies, and federal research and development activities had negligible impacts on price and output. On the other hand, promoting orderly oil markets by encouraging the Interstate Oil Compact Commission and passing the Connally Hot Oil Act was found to have had an unquantifiable but highly significant impact on price and output.

In addition to the conclusions already mentioned for coal incentives, oil incentives point out that those large, capital-intensive parts of solar energy technology that are constructed by large established firms will profit from both investment tax credits and accelerated depreciation. These opportunities include ocean thermal energy conversion and utility solar thermal and photovoltaic electricity generation.

NATURAL GAS

The total value of federal incentives provided for natural gas production was \$16.5 billion. The percentage depletion allowance and expensing of intangible drilling costs increased output by 6.6 quad and held the price down by 10.8¢ per million Btu. The pricing of interstate gas above the level of intrastate gas before 1970 promoted an estimated 6.4 quad of production by encouraging market development. In 1977 prices were 12.5¢ per million Btu lower than they would have been in the absence of controls. As natural gas supply changed from surplus to shortage, wellhead price controls began to reduce production.

Some federal leasing policies have encouraged natural gas production, and others have discouraged it. Prices have been increased by the royalty bonus system of lease bidding. Data-gathering activities have had negligible impacts on natural gas price and output. Regulatory activities of the Federal Power Commission (FPC), now the Federal Energy Regulatory Commission (FERC), other than wellhead price controls, had an unquantifiable effect on the price and output of natural gas.

In the natural gas industry, as in the oil industry, tax incentives led to increased production. Tax credits and accelerated depreciation can lead to increased solar energy usage in large capital-intensive systems. A review of natural gas incentives suggests that government programs that develop the confidence in the stability of supply and in safety can be effective in stimulating production as well as consumption. Just as programs to assure domestic supply, to develop appliances, and to promote safety encouraged natural gas adoption and potential suppliers, the demonstration of the economic feasibility, dissemination of information, and development of efficient and reliable equipment will increase the adoption of solar energy. Codes, licensing, and equipment rating are examples of steps that would help to develop confidence in solar energy usage.

ELECTRICITY

Federal incentives to electricity distribution, transmission, and generation were about \$57.9 billion, about one-third of which went to REA. REA loans increased electrical energy production by 4.97 quad by promoting the distribution of electricity in areas not otherwise apt to be served. The cost savings attributable to low-interest REA loans promoted a \$1.92 per million Btu reduction in the price of electricity, calculated on the fuel used for generation. Traditional services and requirements had a negligible impact on electricity transmission and distribution, although the imposition of antitrust review, environmental analysis, and the like may have significant impacts in the future. Taxation incentives in the form of investment tax credits and liberalized depreciation for privately owned utilities and tax exemptions for publicly owned utilities were estimated to have held down the price of electricity by approximately 34¢ per million Btu. In addition, certain rapidly increasing federal incentives have offset rapidly increasing costs so that recent prices have remained relatively constant.

Subtle accounting changes such as those allowed electric utilities by the Internal Revenue Service, the Securities and Exchange Commission, and FERC could make substantial changes in the renewable energy market. For

instance, very accelerated depreciation or expensing of solar equipment would offset its long payback period. The redirection of the REA could provide an incentive to energy self-sufficiency for some segments of agriculture.

APPLICATION OF THE RESULTS

The findings presented above serve as a point of departure for an incentive strategy to encourage the use of renewable resources. Such a strategy must initially address: (1) total expenditures, (2) choice of incentives, and (3) timing. The findings serve as data to focus debate on these three issues.

Total Expenditures

The \$217.4 billion of federal incentives divided by the 61 quad of induced energy gives \$3.57 per million Btu induced energy. Of the 33 incentives identified, 7 were found to have a quantifiable effect on the quantity of energy produced. Eleven were found to have a quantifiable effect on the price of energy.

The concept of parity was used to estimate the minimum level of expenditures for the future. Parity was defined as an equivalence between federal incentives to renewable energy resources and federal incentives to traditional energy sources. To calculate the level of incentives required to achieve parity, a weighted average incentive in dollars per million Btu for traditional energy forms was developed. Based on the analysis of federal incentives for energy production and the use of this parity index, an average incentive of 27¢ per million Btu for all renewable energy resources would be required to achieve parity with traditional energy resources.

Of course, renewable energy may involve different technologies and institutions than do traditional forms of energy. Also, energy forms or activities are not moral categories, entitled to equal treatment on the grounds of justice. Indeed, the argument for many solar activities is that they deserve more than equal treatment because they serve social values such as national security and environmental quality better than

traditional forms of energy. Nonetheless, parity is a useful starting point because it provides a minimum estimate of needed expenditures. The burden of persuasion ought to be placed on the person who argues that the government can effectively stimulate renewable energy at far less cost than was needed or used to stimulate other forms. He or she should explain why renewable technologies are so much more amenable to stimulation or why the government is now so much more efficient.

Calculating the level of national commitment requires an assumption about the growth of the renewable energy industry. The natural gas industry increased annual production by 17 quad during the 20-year period from 1950 to 1970. Assuming a similar 20-year growth curve for the renewable energy industry, a total increase in production of 152 quad would be necessary to achieve an annual production level of 18 quad by the year 2000. Applying the criterion of parity, an incentive of 27¢ per million Btu times 152 quad would result in a total federal expenditure, from 1980 to 1999, of \$41 billion (1977 dollars).

Choice of Incentives

Of the 61 quad of increased energy production attributable to incentives as a whole, the share attributable to each incentive type is as follows:

- o taxation--33 quad, or 55% (mainly in oil production)
- o market activity--18 quad, or 29% (in electricity and hydroelectricity)
- o requirements--9 quad, or 14% (in oil and natural gas)
- o nontraditional services (research and development)--1.17 quad, or 2% (nuclear power)
- o disbursements--unquantifiable
- o traditional services--negligible.

Taxation incentives, the most pervasive incentive, generally had the greatest overall downward pressure on energy prices. The downward pressure on prices that resulted from market activity was large but limited to hydroelectricity and electricity. It was found that requirements could have positive or negative pressure on energy prices, depending on how they were structured. The price results of alternative incentives do not suggest any changes in the distribution of incentives proposed above

because those incentives with the largest production impacts also had the most significant price impacts.

If dollars are to be allocated among incentive types by the pattern suggested by the estimated results of past incentives to traditional energy production, 55% of the federal investment to stimulate renewable energy production would be in the form of taxation incentives; 29% of the federal investment would be in the form of market activities; 14% would be in the form of requirements; and 2% would be for research and development.

Timing

The historical spending pattern for incentives also serves as a point of departure in designing an incentive strategy for renewable energy resources. During the period 1950-1969 the expenditure for incentives for traditional energy sources was \$102.5 billion (1977 dollars). Taxation incentives generally rose steadily during that time. Requirements rose sharply during the late fifties and leveled. Service rose more rapidly than the others. Market activities fluctuated widely with three distinct peaks and three valleys. Allocating the sum by five-year periods, it was found that 19% of this was expended from 1950 to 1954, 23% from 1955 to 1959, 28% from 1960 to 1964, and 28% during the remaining five years. For the development of renewable and solar energy in the period 1980-1999, similar percentages for five-year periods are reasonable.

CONCLUSIONS

The Federal Government has provided incentives amounting to \$217.4 billion (1977 dollars) to promote the national goals of equity and a better life for the American people. Therefore, much of the result of this expenditure cannot be measured in terms of quantities of energy. But there are lessons that can guide the development of a federal renewable resource energy policy in a way that will transform the tensions among the goals of economic efficiency, national self-sufficiency, environmental quality, and political equity into a creative force to satisfy our needs for work, warmth, and light.

A federal renewable resource energy policy based on historical incentives to traditional sources of energy suggests the level of expenditure would be at least \$41 billion (1977 dollars) during the period 1980-1999. Though this level of commitment can be justified on the basis of equity with nonrenewable energy, it must also be justified on the basis of national goals. The difficulty of measuring the results of expenditures for incentives in terms of energy quantity and price makes developing a measure of national commitment transcend the total expenditure. The impact of the Joint Committee on Atomic Energy, which helped overcome legislative roadblocks to commercial development of nuclear power, is not reflected as a budget item. The economic growth of the Columbia Basin and of the Tennessee Valley is greater than the energy quantity and price results of the Bonneville Power Administration and the Tennessee Valley Authority expenditures. Thus, to be consistent with historical precedent, the expenditure of at least \$41 billion must be justified in terms of goals that are broader than the achievement of 18 quad of renewable energy use in the year 2000.

If the measurable results of historical incentives form the basis of determining the mix of incentives, then a federal renewable resource energy policy would focus primarily on tax incentives and the purchase of utilizing equipment. Requirements such as equipment standards, zoning for access to sunlight, and solar mandating would receive less attention. Nontraditional services, primarily research and development, would be funded at less than a billion dollars.

The timing of expenditures for incentives to induce the use of renewable energy resources would be about \$1.54 billion per year during the 1980-1984 period. During the 1995-1999 period it would increase to about \$2.46 billion per year. New incentives would be added on top of old ones as time passed. However, because total renewable energy production will be much larger toward the end of the twenty-year period, the incentive cost per million Btu will decline over time.

Were the budget for a national renewable energy resource policy based on past incentive policies, it would appear as in Table 2. The use of past policies to achieve future goals may or may not prove to be

TABLE 2. A Point of Departure for Preparing a Federal Incentives Budget for Renewable Energy (Billions of 1977 Dollars)

<u>Incentive Type</u>	<u>Time Period</u>				<u>Totals</u>	<u>Percentage of Total</u>
	<u>1980-1984</u>	<u>1985-1989</u>	<u>1990-1994</u>	<u>1995-1999</u>		
Taxation	4.30	5.19	6.33	6.78	22.6	55
Requirements	1.09	1.30	1.61	1.70	5.7	14
Nontraditional Services	0.15	0.18	0.22	0.25	0.8	2
Market Activity	<u>2.26</u>	<u>2.73</u>	<u>3.34</u>	<u>3.57</u>	<u>11.9</u>	<u>29</u>
TOTAL	7.80	9.40	11.50	12.30	41.0	
Percentage of TOTAL	19	23	28	30		100

successful. There is no guarantee that the future application of historical policies will affect future decisions as they did in the past.

Nevertheless, past actions do set precedents and their estimated results provide useful input for the determination of future policies. The budget in this table is intended to serve as a point of departure for future debate. The application of precedent to current and future conditions is useful because many organizational activities persist in the face of radically different conditions. The procedures, resources, and thoughts of the past and present frame the problem and shape the alternatives available in the future. Consequently, this budget allows the debate to center on the cost of specific actions over relatively short periods of time. So centered, the debate should promote a fruitful exchange of ideas based on the lessons of the past.

CHAPTER III

ELEMENTS OF SOLAR ENERGY POLICY

INCENTIVES RESULTS, DOMESTIC POLICY REVIEW, SAWHILL, AND OTHERS

Jon M. Veigel

The countless studies of a prospective solar energy future or a transition to a solar-based future that the country has produced in the last decade are somewhat similar in my mind to the linear succession of seasonal Caribbean hurricanes. They are conceived in obscure ways offshore and out of view, they are named and born with much fanfare; then they either fizzle out, or they produce results in places and ways that are most unexpected.

Incentives are somewhat like attempts to seed hurricanes. We would like to believe we are smart enough to know how, where, and when to apply them; but our competence in introducing them and in interpreting the results rests more on our assertion of impacts than on our unambiguous ability to trace back from effect to cause. We are caught in the bind of conventional wisdom about incentives. We tend to design solar incentives as incremental adjustments to incentives used for other technologies or other purposes. A perverse consequence sometimes is that the availability of an incentive drives the diagnosis of a solar need. We have to recognize that and be careful about the way in which we react to it.

In some ways, a group like this is rather incestuously inbred. A number of the people here today were here two years ago and the fact that we all know each other is a demonstration of the fact that we know the right people! Nonetheless, this ought to be a group that constantly expands and in which there are new people appearing. We are not going to be responsible by ourselves for the success of a solar future that may or may not come about. The more a group like this, as diffuse as it may be, stays the same into the future, the more likely we are not to succeed. We find that the same people are riding the same charger, and I am among them.

The original Pacific Northwest Laboratory study of incentives produced the sincerest form of flattery, imitation. On that basis the study has been successful. Albeit a callous remark on my part, let me say, "So what? What are you going to do for me next? What's going to

happen as the result of the study that's going to be different than otherwise would have occurred?"

Since 1978 the what, how, when, etc., of national policy formation in solar has been carried out variously under the banners of the National Program for Accelerated Commercialization of Solar Energy, the Domestic Policy Review and the SERI solar/conservation study that I will discuss in more detail later. Deputy Assistant Secretary Bennett Miller is very busily engaged in doing solar market sector planning activities, and Assistant Secretary Stellson is doing a study of his own, looking at both solar and conservation.

The closer any of those studies come to declaring that their sole purpose is to make solar actions real in the world through incentives that are carefully crafted and applied, the more "on purpose" I find it to be. The less that that is the objective, the more I find it to be an exercise in mental masturbation, which while it may be perfectly satisfying, makes it difficult to identify external impacts.

When these studies, as they so often do, go on in parallel to one another, we gleefully steal the best of the ideas from the work of others. After a while, the studies are so homogenized that it is difficult to tell where an idea actually originated. This is a problem only for those with pride of authorship, since the general purpose is still the distillation of a workable understanding of our potential solar futures, the routes that must be traversed to realize them, and the consequences we will experience from them.

The SERI solar/conservation study represents the first time in which we or anybody has really made a valiant effort to combine solar and conservation. The tendency, in the past, has been to have them separated one from another as if they are really going to be separated in the world. In fact, as we each recognize here, solar and conservation considered separately each claim to meet some of the same needs. To avoid the problem of double-counting, we need to see that some of them tend to be mutually exclusive.

The SERI solar/conservation study began early this year when Deputy Secretary John Sawhill asked Denis Hayes to see what we could do along two lines. One is, if we are really serious about the national 20% solar goal, how do we get there? What does it mean? What is it going to look like when we get there? At the same time, how can we maximize the conservation potential of this country? We have been working on it since that time and as late as last Friday afternoon, I learned that Secretary Sawhill still has the results of the study embargoed.

So I will talk about the mechanics of the Sawhill study because I think that part of its credibility is based on the people who have done the major work on it. Then I will go on to talk about, with respect to a couple of market sectors, some particular kinds of results. Because the results are not public yet, I am going to make a deliberate attempt to fuzz the issue of whether the results have come from general SERI work, from the solar/conservation study, or from my own personal idiosyncrasies about some of these things.

The SERI solar/conservation study was organized around a number of different task groups in terms of where solar or energy-efficient systems are going to be applied--in the building envelope, in the industrial or agricultural sectors, in the utility market, in transportation, and one on innovation. In all of those areas we put together a team under the general direction of Henry Kelly. The teams are formed by people at SERI as well as outside consultants. On the buildings area task force, for example, we made heavy use of Professor Art Rosenfeld and his team of people at Lawrence Berkeley Laboratory. In the industry area, we had heavy participation from Professor Marc Ross of the University of Michigan.

I think that what is coming out is, in fact, going to be revolutionary in the sense that we really are trying to crystallize and synthesize a lot of work that has been done around the country. It is coming right at a particularly critical time because in the past we have had neither the wit nor the data to really make some good policy decisions. I think that now, whether we have got more wit or not, we are at least getting more data in some of these areas and are able to find out

what works and what does not work, what the needs are, and what are figments of our imagination.

In the buildings area, looking at both residential and commercial buildings, we use about 27 quads of energy, --13 quad for direct fuel use and slightly over 14 quad for the consumption of primary fuels to generate electricity.

The potential by the year 2000, we estimate, is to reduce this total by about 10 quad with an additional 3-4 quad possible by the application of various kinds of solar systems: solar wind, PV, daylighting, etc. This assumes no change in lifestyle and even with this kind of reduction, most of the building energy consumed in the year 2000 will be consumed by buildings that are standing today. That will be so even though 25% of the buildings standing today will not be standing by the year 2000. And that comes about because the new buildings have the potential to be spectacularly more energy efficient, and their percentage of the total energy consumption will be less than their percentage of the total building market.

This says that the present stock is the prime target while making sure that the new buildings actually meet their potential. Efforts, in my view, must concentrate on supporting those out there whose actions are the sine quo non of success. The final users are those whose decisions in the ultimate sense will determine whether an application actually goes into place or not.

That places the Federal Government in a rather secondary and supporting role, essential, but certainly not by itself able to guarantee the results we see as possible. We need to get the Federal Government out of the way. We need to have the Federal Government delivering on expectations as they are raised because we have certainly seen the effects of creating over-expectations in the past. And finally, the Federal Government can fund/kick the laggards out there whose work we do need to have.

We need to have the Federal Government consolidating innovative ideas, one of which in the building sector is the idea of house doctors.

Sending a team of super-auditors who can go in, find out what the needs are, and then do the job. The TVA has had some recent experience; they sent a team of house doctors into various homes in the TVA area. In one, they discovered a hole in the wall which they started to fill with insulation batts. They heard a noise inside the wall and discovered that they had begun to insulate a cat into the wall which would not have done very much for the R value, I predict, of the wall. In another case they were trying to repair the weather stripping around a basement door. The family dog was watching, the hinges were bad, the door fell off the hinges and injured the dog. In a final example, they put a blower door on to pressurize a house to find the leaks. The invalid woman of the house thought it was too noisy and went off to the bedroom, shut herself in, and forgot there was no handle on the inside of the door. The blower itself made so much noise they did not hear her pounding on the door when she needed to get to her respirator to be able to breathe. It was only by turning off the blower doors that they heard her beating on the door and were able to rescue her in time.

This is the kind of thing that we are going to find happening. This is the type of reality that sitting in a room like this is hard to perceive.

I am going to spend very little time talking about what I consider to be one of the major federal incentive programs for renewable energy resources in the future and that's the MX program. If it goes as predicted, each silo will have 20,000 watts of constant energy demands to be dumped into the world because the IR signature from space would otherwise show a cold hole. One of their sources of energy support is going to be renewable energy. Each of you can imagine outfitting the thousands of holes with biomass, wind systems, or whatever. Also imagine what the impact on the development of solar will be if they introduce military specifications on wind machines. What will that do to the market for wind machines if the size of the federal purchase dominates the annual production for a few years?

In the industrial sector, the conventional focus we have had is on incremental savings due to improvements in energy efficiency and to

applications of particular solar technologies. Indeed, this is important. By the year 2000 we can see a 15 to 35% reduction in energy intensity over what we are presently finding.

These factors alone are not going to be sufficient. They tend to obscure the chance we have to add to what I consider to be the momentum of the economic reality of our industries that we are starting to experience in this country. The opportunity is to use energy in basically new ways, not as modifications of today's technologies. And our code words are going to be productivity and innovation. The pacing issue is capital and where it will come from.

We can start by talking about scrap-and-build programs in which, identifying a sector that is not using energy very effectively, the government would buy the present facilities and then use off-balance sheet joint ventures with the private firm to construct an industrial facility that is, in fact, energy efficient and uses solar. The firm has the right to later buy the facility back from the government.

We hear much in politics today about free enterprise zones like the South Bronx. I would like to suggest a variant, an Energy Enterprise Sector in which we could identify energy-intensive industrial sectors that are vital to the economy and security of the U.S. We could set up highly visible and effective incentives within those sectors to take maximum advantages of conservation and solar in industries with high energy intensiveness, aged capital stock, high employment, and significant export potential.

Finally, I would like to close by noting that there are four different kinds of results that can occur from the applications of incentives. One of them is that we have incorrectible results; coal incentives that lead to an increase in the necessity for black lung benefits are an incorrectible result. Many incentives, particularly the ones we have introduced in the past, have no consequences; we put them in place and, lo and behold, nothing happens. I think we are at the stage today where we are introducing incentives that have correctible results and are almost on target, or near enough on target so that with some fine tuning we can get them in shape and have them produce the results we

expect of them. An example is to increase the tax credit percentage for residential applications of solar and conservation. And finally, what we are all striving for is that the incentives that we design and put in place will all actually have the desired results. I cannot point to too many examples in the past where this has been true. It is my fond hope that next time an expanded group like this gets together, we will be able to discuss the problems we are facing in coping with the success of solar and conservation.

SOME BENCHMARKS FOR ESTIMATING THE MAGNITUDE FOR SOLAR INCENTIVES

Gerald E. Bennington

The work of Bruce's team⁽¹⁾ resulted in a proposed parity level of .27 \$/million Btu for solar. They further propose a \$41 billion budget for 1980-1990 to achieve an 18 quad increase in solar utilization. In response to the instructions for the meeting, I have prepared some comments on the use of the incentives study for designing solar incentives.

To maintain consistency, they may want to recompute their parity value to remove hydro from the conventional energy base. The Domestic Policy Review⁽²⁾ and the President's 20% goal⁽³⁾ explicitly included hydro as a solar technology. Repeating their calculation without hydro yields roughly .26 \$/million Btu. We can ignore the difference for practical purposes, but it may make for a better presentation.

In 1978 we had roughly 3 quads of hydro and 1.6 quads of biomass, so solar was already contributing 4.6 quads to the nation's energy budget. An additional 18 quads would yield a total contribution of 22-23 quads in the year 2000. This level of solar growth is probably too high to plan against, since the 20% goal was based on a 95 quad base and a total solar contribution of 19 quads. A solar contribution of 14 quads is more practical and consistent.

If we take a look at historical solar incentives, in a similar manner to the Battelle study, we will need to complete the following two tables. The tables have been completed with the data currently available.

TABLE 1. Solar Incentives 1933-1977

	<u>Incentives</u> <u>(Millions of \$)</u>	<u>Production</u> <u>(Trillion Btu)</u>	<u>Incentive Value</u> <u>(\$/Million Btu)</u>
Hydro ^(a)	26,850	27,760	1.13
Biomass	182 ^(b)	>20,000	<.009
Other Solar	<u>?</u>	<u>?</u>	<u>?</u>
	27,032	>47,760	<.56

(a) Cone et. al. 1980.

(b) Conservation and Solar Fact Book.

TABLE 2. Solar Production and Incentives During 1977

	Incentives (Millions of \$)	Production (Trillion Btu)	Incentive Value (\$/Million Btu)
Hydro ^(a)	999	799	1.28
Biomass	290 ^(b)	1,600	.001 ^(c)
Other Solar	<u>?</u>	<u>?</u>	<u>?</u>
	1,290	2,400	.54

(a) Cone et al., 1980.

(b) Annual Review of Solar Energy.

(c) Based on Department of Energy biomass budget of 1.9 million.

With Department of Energy budgets of 514, 596, and over 650 millions in FY-1979, 1980, and 1981 respectively,⁽⁵⁾ it might appear that solar is already well subsidized. This is hardly the case, since most of the additional energy contributions from solar are expected through a dramatic increase in solar technologies other than hydro and biomass: active and passive heating and cooling, large and small wind, solar thermal, photovoltaics, alcohol fuels, and OTEC.

Bruce's analogy to natural gas may also be a little misleading. A linear growth of 17 quads over 20 years would have a cumulative total of 170 quads. Bruce had 144. Based on a recent study⁽⁶⁾ using the SPURR Model,⁽⁷⁾ the solar growth is likely to be more nonlinear than the gas example. Solar is still on the early part of its initial growth. A curve for 18 quads of new additions might look like the following.

Alternative 18 Quad Scenario (Quads)

	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>
Annual Solar Energy Savings	5	6	14	23
Additions Since 1980	-	1	9	18
Cumulative Energy Savings Since 1980	-	27	77	263
Net Cumulative Energy Savings Since 1980	-	2	27	163

An issue that Bruce's \$41 billion budget ignores is that the 27 ¢/million Btu subsidy is for the energy production over the system lifetime. With the bulk of the systems being installed after 1990 their lifetimes will run past 2010. This means that there is an implied subsidy of 20-25 billion for the period 2000 through 2010.

Last, in the National Plan for the Accelerated Commercialization of Solar Energy,⁽⁶⁾ we analyzed subsidies \$.90-1.20 per million Btu which were based on a parity level subsidy and a national value subsidy. The market analysis indicated that a market subsidy of over 100 billion would be needed to yield a 23 quad scenario. (The 19 quad case, similar to the Domestic Policy Review, was roughly 60 billion.) This implies that the solar incentives may need to be well above the parity level to achieve a major solar growth by the year 2000.

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BOOZ, ALLEN AND HAMILTON SOLAR MARKET RESEARCH ACTIVITIES

William H. Babcock and Michael R. Sedmak

The underlying purpose of the various solar market research activities undertaken at Booz-Allen over the past two years is to develop sets of tools and data that will improve the Department of Energy's (DOE) ability to evaluate the need for, and effectiveness of, alternative solar market development programs and strategies. In so doing, we have approached the development and analysis of incentives from the opposite direction than that taken by the Battelle team. Essentially, our approach has been a bottom-up approach, building on the behavior of market participants rather than an aggregate, top-down, utilizing the Booz-Allen historical data.

A major contribution of this research is the development of a set of methodologies that can be used to obtain qualitative, and some quantitative, information about these matters:

- o the general shape and relative location of the demand and supply curves for different solar technologies and applications
- o the interaction between the demand and supply sides of the different solar markets.

The purpose of this paper is to briefly describe the methodologies developed and the types of data gathered and to discuss the implications of the Booz-Allen research and Battelle research for solar policymakers.

THE DIFFERENCE BETWEEN THE BOOZ-ALLEN APPROACH AND OTHER RESEARCH

To date, DOE has relied upon solar market penetration models, predominantly the System for Projecting the Utilization of Renewable Resources (SPURR) model developed by the MITRE Corp., to analyze the effects of alternative federal solar market development strategies on the rate of commercialization of solar technologies. Other major solar market penetration models include the ADL Solar Heating and Cooling of Buildings (SHACOB) Commercialization Model, the SRI Solar Penetration Model, and the EEA/MOPPS Industrial Energy Technology Model. The limited usefulness of penetration models in evaluating the effectiveness of solar policies is well documented and will not be discussed in detail in this paper.⁽¹⁾

It is most important, however, to understand the difference between Booz-Allen's approach to formulating solar policy tools and that taken by existing solar market penetration models. Essentially, existing solar market penetration models compress all of the various economic and noneconomic factors affecting demand and supply, as well as the interactions between the demand and supply sides of the industry, into a logit function or similar equation(s) that relate percentage market penetration to time.

The factors affecting demand and supply, as well as the treatment of these factors by most existing solar market penetration models, are listed in Figures 1 and 2. Note that all of the economic factors affecting demand are compressed into a figure of merit (FOM), a single parameter, (normally a life cycle cost ratio or payback period) which is supposed to represent the economic attractiveness of solar relative to competing energy sources. The important noneconomic factors affecting demand are normally compressed into a behavioral lag, or market attenuation, function, which attempts to model how consumers react to these noneconomic factors, especially while the market is in its development phase. As shown in Figure 2, the complex supply side of the solar market is normally modelled by assuming that costs will fall as cumulative production rises (the "learning curve" approach). However, without an analysis of the important factors affecting supply, such as the industry structure, its stage of development, and its technology delivery system, the validity of employing this learning curve approach cannot be evaluated.

Booz-Allen's approach is to go behind the logit function used in market penetration models and perform more detailed analyses of the factors affecting the demand for and supply of solar products. It is felt that much more valuable information can be made available to policymakers by employing this latter approach. A discussion of the Booz-Allen research is presented in the following two sections of this paper. A summary of the important contributions of the three major studies undertaken in our solar market research program is presented first, and then the value to policymakers of integrating the results of this research into a simple demand/supply framework is demonstrated.

FACTORS AFFECTING DEMAND

- Economic

- First Cost
- Fuel Savings
- Financial Incentives
- Discount Rate
- Method of Finance
- Interest Rate
- Tax Considerations
- O & M Expenses

- Noneconomic

- Differences in Consumer Preferences
- Resistance to Change
- Familiarity
- Uncertainty Regarding Performance
- Perception of Reliability
- Aesthetics

TREATMENT BY FIRST GENERATION SOLAR MARKET PENETRATION MODELS

- FOM
 - Life Cycle Cost
 - Payback

- Behavioral Lag

FIGURE 1. Demand Modeling

FACTORS AFFECTING SUPPLY

- o Industry Structure
 - Type and Number of Firms
 - Competitive/Oligopolistic
- o Stage of Development
 - R & D
 - Early Commercialization (Cost Reduction Potential Exists)
 - Mature (Little Potential For Cost Reduction)
- o Technology Delivery System
 - Potential for Scale Economies
 - Potential for Cost Reduction Through Learning
- o Distribution Network
- o Installation Procedures

TREATMENT BY FIRST GENERATION MARKET PENETRATION MODELS

FIGURE 2. Supply/Cost Reduction Modeling

SUMMARY OF THE IMPORTANT CONTRIBUTIONS OF THE SOLAR MARKET RESEARCH STUDIES

As mentioned above, the primary goal of Booz-Allen's solar market research activities was to develop sets of tools and data that will most effectively assist DOE in formulating effective solar market development strategies. The major accomplishments to date in meeting this goal have come from three interrelated studies: Solar Market Supply Analysis, SHAC Evaluation Project - Phase I, and Buyer Behavior Analysis. The contributions of each of these studies are summarized in the following paragraphs.

Solar Market Supply Analysis

SPURR and most other solar market penetration models assume that solar costs will fall as production rises. These cost decreases are normally attributed to a combination of scale economies and learning. Unfortunately, there are no theoretical or practical foundations for these assumed cost reductions. To remedy this situation, the actual cost reduction potential for five generic solar technologies (active space and water heating, passive space heating, wood, wind, and photovoltaics) was analyzed. Where possible, the study attempted to identify cost reduction potential in each component of the system, as well as at each step in the product's technology delivery system.

One of the major accomplishments of the Solar Market Supply Analysis was the estimation of a long-run average cost function for the present generation of flat-plate solar collectors. The type of information inherent in an average cost function in conjunction with data on distribution and installation costs and information on the industry structure, including the number, capacity, and location of plants in a given region, can be used to estimate a long-run average cost (or long-run supply) curve for a solar thermal product in a given region.

On the basis of our solar market supply research, we feel that the long-run average cost (LRAC) curve depicted in Figure 4 represents the general shape of the LRAC curve for the present generation of active solar thermal systems. Note that no numbers have been placed on the axes, as the industry-wide quantitative analyses necessary to estimate the price at

which a given number of solar systems will be supplied have not been performed. However, it will be shown in the next section that some rather valuable policy analyses can be conducted as long as the relative positions of the supply and demand curves for the product in question are known.

SHAC Evaluation Project

In view of the fact that no industry wide quantitative data existed at the beginning of our research, DOE directed the project to obtain data on both the number of solar installations in various regions of the U.S. and the cost and performance of these systems. The information for solar heating and cooling (SHAC) systems was to be obtained from the SHAC Evaluation Program, which was initiated by DOE in early 1978. The major objectives of Phase I were to determine the feasibility of establishing a SHAC data collection and analysis system and to conduct a pilot test of the remote data collection method.⁽²⁾ Phase I has been successfully completed. It is felt that rapid implementation of the SHAC Evaluation Program is a critical component of DOE's efforts to develop cogent, efficient solar policies.

Buyer Behavior Study

Early solar market research and theories of product diffusion indicate that the current demand for solar is likely to not be based on straightforward economic criteria. There are some people who buy solar systems that are more expensive than conventional energy sources perhaps because of some perceived increase in status, or because of having a value system which may be described as "voluntary simplicity."⁽³⁾ In contrast there are other markets where there is little demand for solar domestic hot water systems, even though they compare well economically against traditional water heating systems.

An important question for policymakers, then, is how can federal programs affect consumers' decisions to buy solar energy systems? The objective of Phase I of the Buyer Behavior Study was to develop and test a method for obtaining some of the answers to this rather complex question. The heart of the Buyer Behavior approach is a sophisticated market

FIGURE 3. Long-Run Average Cost Curve

research methodology. This approach has been termed "buyer behavior" because it focuses on generating probability of purchase functions that represent the empirical judgments of potential buyers of solar systems. Probability of purchase functions are mathematical functions that relate the probability of purchase of a solar system to a set of economic and noneconomic variables.

One of the major accomplishments of this research is the development and successful testing of a methodology for estimating "market saturation functions" for various solar applications. Market saturation, as used here, is defined as the expected percentage penetration of a product in a mature market. (A mature market is one in which all of the obstacles that hinder the development of a new market, such as lack of familiarity with the product, resistance to change, and uncertainty with respect to the product's performance and reliability, have been eliminated.) These market saturation functions express expected percentage penetration in a mature market (market saturation, MS) as a function of the capital cost of the solar system (FC), the average annual after tax dollar savings (primarily fuel savings) generated by the solar system (FS), and the amount of government case subsidy or equivalent financial incentive (SUB). That is:

$$MS = f(FC, FS, SUB) \quad (1)$$

Once statistically valid market saturation functions have been generated, these functions can be used to derive demand curves for the solar applications being analyzed, when combined with data on:

- o the number of solar systems sold in the past year (available from a fully operational SHAC Evaluation System)
- o the potential market for the application at the present time
- o solar system cost and performance (including operating and maintenance expenses)
- o back-up fuel prices
- o the tax treatment of the system owner
- o available solar-specific financial incentives.

Once market saturation functions have been estimated and the data listed above has been collected, reasonably accurate estimates of the number of

solar systems that could be sold in a given year at various solar system first costs could be generated.

IMPLICATION OF BOOZ-ALLEN AND BATTELLE RESEARCH FOR SOLAR POLICYMAKERS

The ability to estimate the present demand for solar products is a unique and, in our estimation, extremely valuable contribution of our solar market research. First, this demand estimation technique makes it possible for solar policymakers and industry participants to obtain a reasonably accurate estimate of the number of systems that could be sold at different systems prices in a given year. To our knowledge, the ability to estimate the demand for a product in the absence of rather substantial time series data has not previously existed. Second, and probably more important, estimates of the demand for a solar product can be combined with the supply curve estimates that can be generated through an extension of the Solar Market Supply Analysis methodology so that the relationship between today's demand and supply curves for the solar application in question can be analyzed.

Hypothetical but representative demand supply curves for active solar thermal systems are shown in Figure 5. From the relative positions of these curves it can be seen that the present market for active systems cannot support high-volume production and sales. On the basis of the Solar Market Supply research, a sustainable mass production market must be achieved if the active contribution to the President's goal of 20% solar by the year 2000 is to be met. In view of this fact and the present market situation depicted in Figure 5, the challenge facing policymakers today is to determine what programs can most efficiently assist the marketplace in moving to a mass production environment.

The major benefit of bringing the results of our research together in the demand/supply framework presented here is that this approach can easily be used to analyze the probable effects of the various options available to solar policymakers. In addition, with the implementation of a systematic data gathering program, it will be possible to analyze and evaluate the historical results of government incentive programs.

Market Saturation = f (First Cost, Fuel Savings, Subsidy)

FIGURE 4. Relationship Between the Demand and Long-run Supply Curves for Active Solar Thermal Systems

The Booz-Allen research has established the validity of a set of methodologies for conducting solar policy analyses prior to the implementation of specific government incentives or programs. These methodologies are basically consistent with the approach taken by Battelle in its historical analysis of government incentives to the energy sector. By combining the lessons learned regarding data requirements and data availability from the Battelle experience, with the methodologies developed by Booz-Allen, it would be possible to establish an effective data-gathering program to track the development of the solar market.

The next few years offer a unique opportunity to essentially conduct a policy experiment analyzing the impact of alternative government incentive programs on the rate of solar energy development. The policy experiment will unfold with or without an effective tracking mechanism. However, the ability to draw specific conclusions will be severely limited if not impossible, if steps are not taken soon to implement the required data gathering and analysis activities.

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CURRENT VERSUS SUNK SUBSIDIES: ISSUES AND DIRECTIONS

F. T. Sparrow

Advocates of solar energy assert that conventional energy sources are systematically underpriced due to a variety of governmental programs, and thus solar energy faces unfair competition in the open market. For the nuclear industry, they cite the enormous research and development investment made by the government in the civilian reactor development program, the indirect subsidy received by the industry because enrichment plants sold (and sell) their services below cost, and the nonquantifiable cost of the Price-Anderson Act. The Battelle study estimated that such subsidies amounted to \$18 billion through 1977. The same study estimated that the hydroelectric power industry has received \$15 billion in subsidies, that the oil industry received \$101 billion in subsidies, that natural gas subsidies amounted to \$16 billion, and that another \$51 billion in subsidies have been granted for electric power generation, transmission, and distribution. This study represents the most comprehensive effort, to date, to consistently measure federal subsidies for energy development. The task here is to convert these historical subsidies into estimates of how much these subsidies reduce current energy prices. This presents several difficulties.

First, for the relevant subsidies mentioned above, does it necessarily follow that solar energy is "entitled" to equivalent treatment? Not necessarily. The problem is that much of the embedded subsidies granted to conventional energy sources can be justified by the presence of some externality or national goal that the particular incentive or subsidy was designed to offset. For example, governmental R&D subsidies to the nuclear industry were designed to offset systematic underinvestment in such work by the private sector because of the magnitude of the R&D effort required, excessive risk aversion by the nuclear industry, and the inability of the private sector to capture all the benefits of that R&D. The key to what subsidy a particular good or service is entitled to is not necessarily what its competitors receive (or

have received), but to what extent the public benefits of consuming the good are not measured in the cost. Thus, just because conventional energy prices are reduced by x cents per 10^6 Btu (because a taxpayer is paying for the R&D in his tax bill rather than the purchaser of energy in his energy bill) does not justify subsidizing solar energy to the same degree. Rather, the appropriate level of subsidy for solar energy is that which will produce a level of solar energy development in line with social costs and social benefits.

The ultimate conclusion of this line of reasoning is to say that solar energy is entitled to subsidies on efficiency grounds only for those subsidies and incentives granted conventional fuels which are "improper," i.e., cannot be justified by appeal to some common good. What is necessary is a categorization of the various incentives by the externality they were designed to correct in order to determine the current appropriateness of the purposes. For example, the purpose of the \$14 billion paid oil and gas producers and landowners by allowing the expensing of intangible drilling costs was to "encourage oil and gas producers to bring in more wells," thus, increasing reserves. The impact of the depletion allowance was to increase production, thus, decreasing reserves. The former motive is still appropriate, while the latter is not. One could argue that solar energy is entitled to a subsidy equivalent to the depletion allowance, since the substitution of solar energy for oil and gas brought about by the subsidy would increase proved reserves.

Finally, to what extent should past, or "sunk," subsidies enter into the calculation? It has been argued that any correction should be based on current subsidies which allow current conventional energy to be sold below its true cost. The view rejects the claim that past, or "sunk" subsidies should be used to justify additional current solar subsidies. The asymmetric impact of past, or "sunk" versus current subsidies upon the "proper" level of a solar subsidy is especially apparent in the case of a nonrenewable resource such as oil, gas, coal, and the like. In this case, since past subsidies reduced past prices, thus increasing past use (Battelle estimates around 60 quads) there is less oil and gas to

consume. In later years, this reduced supply results in higher current prices for nonrenewable resources than would be the case without the past subsidies.

Thus, sunk subsidies make it easier for solar to compete, since conventional energy prices are higher than they "should be," exactly opposite to the impact of current subsidies to conventional fuels, which make it harder for solar to complete. Solar energy should be subsidized in direct proportion to current subsidies, and in inverse proportion to past subsidies.

What is required is to identify existing subsidies which: (1) have an influence on current energy prices and are expected to continue to do so in the near future; (2) are designed to achieve a social goal no longer consistent with current national policy. Solar energy is entitled to a subsidy in proportion to these subsidies. Table 1 gives the results of these calculations.

The determination of which subsidies have an impact on current energy prices is usually straightforward, since data on many of the subsidies are presented on an annual basis, and in most instances it was reasonable to assume that yearly subsidies affected yearly prices. A problem arose in allocating R&D subsidies. Since R&D is usually treated as an investment, it should be depreciated, rather than expensed. Such a treatment would reduce the 1977 total below that in the table, but not by enough to significantly influence the results. The cost of oil regulation was figured on the basis of the difference between actual oil prices and OPEC prices; gas regulation as the difference between interstate and intrastate prices.

The task of determining which incentives were proper and which improper was more difficult. First, the incentives provided through R&D subsidies were assumed to be proper corrections of a tendency for systematic underinvestment in R&D by the private sector, and, hence, did not contribute to a "proper" level for solar subsidies. Such subsidies justify the current policy of federal funding of solar R&D projects. Subsidies designed to encourage maintenance of domestic reserves (exploration subsidies, intangible drilling expense) were ruled "proper"

TABLE 1. Incentives Classification (1977 Million Dollars)

	Total	1977	"Improper" Subsidy Amount
I. Nuclear			
R&D	15,100	1,228	0
Liability insurance	n.a.	10	10
Enrichment plant	1,800	0	0
Uranium industry	n.a.	<0	0
Waste management	n.a.	250	250
Regulation	1,124	146	146
	<u>18,000</u>	<u>1,384</u>	<u>406</u>
II. Coal			
R&D	2,500	441	0
Exploration	146	11	0
Depl. Allowance	4,026	443	443
Mine Health, Safety, Data	719	77	0
Transportation	2,308	90	0
	<u>9,707</u>	<u>1,062</u>	<u>443</u>
III. Oil			
R&D	1,022	49	0
Exploration, data and management	940	156	0
Stripper regulation	n.a.	0	0
Old oil regulation	n.a.	11,500	11,500
New and released oil regulation	n.a.	2,280	2,280
Intangible drilling expense	14,163	742	0
Depletion allowance	36,230	553	553
Foreign tax credit		0	0
Oil tax credit	5,199	0	0
Port and waterways	5,984	298	0
Tanker subsidy	1,120	130	0
		<u>15,708</u>	<u>14,333</u>
IV. Gas			
Exploration data and management	399	57	0
Drilling expensing	4,066	463	0
Depl. allowance	11,979	1,148	1,148
Wellhead price controls	170	2,534	2,534
		<u>4,202</u>	<u>3,682</u>

for the same reason. Depletion allowances and oil and gas price regulation, since they tend to decrease domestic reserves, were considered improper, and were included in the solar subsidy calculation. Subsidies given coal, oil, and gas through subsidies to tankers, railcars, and waterways were considered improper, since there appears to be little justification or support remaining for these measures, given the push towards deregulation of the transport industry. The subsidies to the nuclear industry are counted in the form of enrichment plant and waste management services, and liability insurance sold below true cost.

It should be emphasized that this analysis assumes the world price of oil per barrel accurately reflects the true world cost of oil. In fact, the price is dominated by OPEC cartel profit. Hence, to argue that solar energy faces unfair competition from oil, since domestic oil is held below a price inflated by the cartel position of the supplier, is hardly a totally convincing argument, particularly when economists have estimated the "socially optimal" price of a barrel of oil to be much lower. On the other hand, the resource opportunity cost of imported oil to the United States is certainly the price of that oil, since that is the value of the goods and services leaving the United States to pay for the oil, and, hence, unavailable for domestic use.

To convert these figures for use in estimating the degree of underpricing percentage, several adjustments must be made. First, the underpricing for nuclear, coal, oil, and gas must be expressed in terms of cents per Btu input, not end use. In 1977, .85, 16.5, 23, and 18.6 quads of nuclear, coal, oil, and gas were produced. Thus, the underpricing per delivered 10^5 Btu were 48¢, 1.6¢, 62.3¢, and 19.7¢ respectively. In 1977, the average price paid by utilities for coal, oil, and gas was \$0.90, \$2.33, and \$1.60 per million Btu, respectively. The average cost of nuclear power generation has been estimated at \$7.30 per million Btu. Thus, the underpricing represented 7%, 3%, 27%, and 13% of the cost of nuclear power, and the purchase cost of coal, oil, and gas, respectively, to the utilities. On efficiency grounds, solar energy is entitled to subsidies in proportion to this amount of underpricing.

No attempt will be made to estimate the degree of present overpricing of conventional fuel sources due to past, or "sunk" subsidies due to the difficulties involved in developing the demand and supply elasticity data. It is evident that the overpricing is a significant figure, since 5¢ a million Btu natural gas was a common cost in the late 50s when production was artificially encouraged by the subsidies. Would that we had conserved some of that premium gas for consumption now, rather than consumed it then!

REGULATORY INCENTIVES FOR SOLAR ENERGY USE IN URBAN SETTINGS

Alan S. Miller

Overview and Conclusion

The most frequently discussed incentives for solar energy users are subsidies--tax credits, loans, property tax exemptions, etc. However, the importance of nonfinancial incentives for new technologies is being increasingly recognized. Economics is only one of many factors that influence the process of technological innovation. The building industry, because it is draft-based and highly decentralized, is notoriously slow to adopt new products, even when their economic and technical merit is well demonstrated.

Many nonfinancial incentives to market development are evolving, such as regulations mandating use of solar hot water heaters in areas short of natural gas. In the short term, however, the most feasible nonfinancial incentives may be planning procedures that often can be implemented with little cost or controversy. Such provisions can create a regulatory climate that educates builders and developers about the potential of solar energy in their area, can reward those who include solar access considerations in their proposals, and can protect the opportunity for future building owners to incorporate solar systems. While the impact of this type of legislation is difficult to quantify, evidence exists that it can be done without unreasonable administrative expense, without distorting other planning objectives, and without major legal change. It therefore is worthwhile as part of an overall program to create a favorable regulatory climate for solar energy.

Discussion

It is axiomatic that solar energy systems must have access to sunlight to operate. In rural and low density residential neighborhoods, this will rarely be a major problem. In medium and high density neighborhoods, however, shading problems are a serious issue. Obstructions during even part of the day can have a significant impact on collector output and system economics. The problems are greatest for

passive systems, wall and ground-mounted collectors, since the access to sunlight crosses lower on adjoining property.

Protecting solar access is considerably easier in areas without substantial existing development. Numerous studies have shown that solar access can be provided consistent with medium densities, particularly if an envelope concept is adopted in designing buildings. Several communities, including Lincoln, Nebraska, and Port Arthur, Texas, review subdivision applications for consistency with solar access criteria. In Lincoln, a density bonus of up to 20% is given to developers who meet energy-efficient site design criteria. Because the procedure was optional and already involved substantial negotiation, few problems have been reported.

Port Arthur's requirements for passive orientation are mandatory but reportedly have widespread support and are adopted easily. However, very few plans have been reviewed so far.

In both communities legal protection is subject to future zoning changes. However, developers could provide legal certainty by incorporating restrictive covenants in the title to each property sold.

The issues in an already-developed area are far more complex. Conflict with existing land uses and a much greater administrative burden are potential problems. A study in Los Angeles estimated that as many as 6,000 proposals might be submitted for review in a year. However, these problems could be substantially mitigated by eliminating neighborhoods where solar access is clearly impossible, or by giving blanket protection to areas where problems are found to be insignificant. The City Attorney concluded that the city clearly has authority to adopt solar envelopes to protect solar access and recommended doing so through an amendment to the general plan or by a city-wide zoning ordinance. However, some developers expressed reservations about the added costs such regulations would create, and advocated substantial opportunity for exemptions where conditions for solar energy are not promising.

The Los Angeles experience is not unique. Many other cities are evaluating similar ordinances. The importance of modifying existing

planning procedures is clear because of the impact on existing land use. Some trade-offs must be made, probably in the hours of protection and in the elevation and placement of the areas protected. Developers and energy experts must be brought together to discuss these concerns, as the interests of each must be accommodated, city by city, nationwide.

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THE SOLAR BANK: A NEW ENERGY INCENTIVE

Arthur J. Reiger

Introduction

The Solar Energy and Energy Conservation Bank was authorized by Title V, Subtitle A of the "Energy Security Act of 1980" (Public Law 96-294), signed into law by President Carter on June 30. The establishment of the Bank is considered to be the most significant Federal legislative action to stimulate the use of solar energy since the passage of the residential energy tax credit.

The purpose of this paper is to provide an introductory description of the structure and powers of the Bank as it relates to solar energy. As appropriate, reference will be made to similarities and differences with prior Federal incentive programs that have been used to stimulate the production of nonrenewable energy sources.

Structure of the Bank

The Bank will be organized as a new entity within the U.S. Department of Housing and Urban Development (HUD). It will be governed by a Board of Directors consisting of the Secretaries of HUD (as Chairperson), Energy, Treasury, Agriculture, and Commerce. The Board will provide overall policy direction, while day-to-day management responsibilities will rest with the President of the Bank, who is appointed by the President of the United States with the advice and consent of the U.S. Senate.

The legislation calls for two Executive Vice Presidents, one for solar energy and one for energy conservation. In addition, there are two Advisory Committees, one for solar energy and one for energy conservation. Members will be selected by the Board to reflect the views and interests of various elements of the private sector and consumers.

The views expressed are solely those of the author and do not necessarily represent those of the U.S. Department of Housing and Urban Development.

Unlike some earlier incentive programs, the Bank has been placed within an existing department. HUD was selected as the appropriate agency because of its experience in residential financing and because at least 70% of the Bank's solar funds must be used in residential buildings. However, the Bank has been given special status as a separate entity within HUD and has been given the same corporate powers as the government National Mortgage Association. This latter provision provides somewhat more flexibility than would normally be the case for a new Federal program. In addition, the other members of the Board and the Advisory Committees will provide a broader perspective on the Bank's programs than might be the case if the Bank were either an independent entity or an integrated program function within a single agency.

Bank Subsidies

Subsidy funds will be provided to local financial institutions. The funds in turn will be used by financial institutions to reduce the interest rate or principal obligation on loans made to borrowers for the purchase and installation of solar energy systems. It is important to note here that the subsidy is always part of a larger package of financial resources i.e., a loan for the solar energy system, and, in the case of new housing, a mortgage loan to finance the entire house as well as the solar energy system.

The subsidy funds will be conveyed to financial institutions as lump sum, upfront payments. The loans themselves are not provided by the Bank nor are special provisions provided to guarantee or insure the loans that are made by financial institutions. As a result, the basic underwriting of loans is done by the financial institution and the involvement of the Bank is limited to the solar aspects of the loan. This form of subsidy is based in part on the development of the Federal Government's housing assistance programs where, over time, the public involvement has been reduced so that such elements as direct Federal lending, special Federal loan guarantees, and the use of annual subsidy payments over the life of a loan, are not as frequently utilized.

The legislation specifies different maximum levels of subsidies depending on the type of building that is being assisted. For single

family homes, the maximum amount of Bank financial assistance is \$5,000. This amount of subsidy would reduce the interest rate on an \$80,000 mortgage loan about 1%, i.e., reduce monthly mortgage payments by about \$60 per month. The impact of the subsidy, of course, varies as a function of the size of the overall mortgage loan and the market interest rate.

Within the limits imposed by the maximum levels of financial assistance, the legislation directs the Board to establish subsidy levels based on a consideration of a number of factors including: the availability of other Federal incentives, the costs and efficiencies of nonrenewable energy sources and systems and solar energy systems, and the level needed to induce market demand to purchase and install solar energy systems.

Eligible Solar Technologies

The legislation provides a broad definition of eligible solar energy technologies including: passive and active solar energy systems, wood burning appliances, solar process heat devices, solar electric devices, and earth sheltered buildings. While the list of solar technologies is quite inclusive, the legislation envisions an initial focus on technologies that have moved out of the demonstration phase and where there are standards available as well as some installation and servicing capability.

The basis of the subsidy also varies by the type of eligible solar technology. For example, the subsidy for an active solar energy system is based on a percentage of costs up to the specified maximums. For passive solar energy systems, the amount of the subsidy shall vary by an estimate of the amount of energy to be saved up to the statutory maximums. This special provision is based on a recognition of the difficulty of separating out passive solar features from the overall costs of the building structure as well as an intention to relate Federal subsidies directly to potential energy savings.

The Bank is currently developing operational instructions to allow financial institutions to make subsidy determinations based on estimates of energy saved by passive solar energy systems in different locations.

The legislation directs the Bank to extend this provision to active solar energy systems in 1983 unless it finds that varying the subsidy by the estimated amount of energy to be saved is not practical.

Eligible Buildings

Financial assistance can be provided for the purchase of and installation of solar energy systems in a wide range of building types. They are new and existing residential buildings, commercial buildings, and agricultural buildings. The maximum subsidy amounts vary by the type and size of the building. For residential buildings, the maximum amounts are \$5,000 for single family homes; \$7,500 for two family buildings; \$10,000 for three or four family buildings; and \$2,500 per dwelling unit for larger residential buildings. For commercial and agricultural buildings, the maximum amount of assistance is \$100,000. However, as noted earlier, at least 70% of the solar funds must be used for residential buildings.

Eligible Recipients

Owners and purchasers of residential, commercial, and agricultural buildings who are financing the purchase and installation of solar energy systems are eligible to receive Bank subsidies through local financial institutions. There are no income limits for recipients of Bank subsidies. However, household income can affect the maximum percentage of the subsidy amount, within statutory limits for residential buildings. For example, in the case of a single family home with an active solar energy system, the maximum subsidy for a household with an income over 160% of the area median income is 40% of eligible costs up to \$5,000, compared to 50% and 60% of eligible costs up to \$5,000 for families with incomes under 160% and 80% of area median incomes respectively. These income provisions do not apply to passive solar energy systems where the subsidy is based on an estimate of energy savings.

The Board may also extend subsidies to builders to encourage the construction or substantial rehabilitation of residential buildings (1-4 dwelling units) with solar energy systems. If this provision is implemented, the purchasers of these buildings could not receive

additional financial assistance from the Bank, but might be able to share the Bank subsidy with the builder.

Recipients of Bank subsidies are also prohibited from receiving a Federal residential energy tax credit for the same solar energy system. There is one additional important point to be made about the Federal energy tax credit. Unlike the tax incentive where taxpayers are entitled to receive a credit for eligible expenditures, the Bank's programs provides only eligibility for financial assistance. The availability of Bank subsidies to individual borrowers will depend on whether they can arrange a loan with a financial institution and whether the financial institution has a commitment for subsidy funds from the Bank. With regard to the latter requirement, the total amount of subsidy funds will depend on appropriations made by the Congress. The solar funding authorization level for FY-1980 is \$100 million, for FY-1982 is \$200 million, and for FY-1983 is \$225 million.

Other Features

An important function, which is described in a separate section of the legislation, is that of promotion. This includes promotion of the Bank's programs, but also extends to more general information on solar energy as well as technical assistance to nonprofit entities and local governments on the use of the Bank's programs. Maximum funding for the Bank's promotional efforts is \$10 million for FY-1981, \$7.5 million for FY-1982 and \$7.5 million for FY-1983. The promotional efforts are not to duplicate other Federal programs.

The Bank, under the promotion section, is also to seek the advice and assistance of the Federal Home Loan Mortgage Corporation and the Federal National Mortgage Association to coordinate its programs with the secondary mortgage market. This provision is related to the authority of the Bank to implement its own secondary market operation, if needed, to stimulate the use of solar energy. The more likely occurrence will be incorporating mortgage loans with solar energy systems into the existing secondary market operations rather than creating new channels.

Conclusions

This paper has provided a broad overview of the Solar Bank. In summary, the Bank will provide subsidies for solar energy systems as part of loan packages made by local financial institutions. The structure and powers of the Bank incorporate elements of earlier incentive programs in the areas of both housing and energy, but also are a distinctive way of encouraging the use of solar energy. Since the Bank's programs are not yet operational, it will be some time before any evaluation of the success of its activities can be made. However, the Bank will provide a focal point for Federal efforts and as such its operations will be a major indication of the Federal Government's ability to stimulate the use of solar energy in the private buildings' sector.

RESULTS OF ARIZONA'S SOLAR INCENTIVE PROGRAM

James F. Warnock
Robert L. Sears

Arizona is located in a region of abundant sunshine but with limited fossil fuel resources. Solar energy is perceived as an increasingly important energy resource for the state and a means by which we can reduce our requirements for conventional forms of energy. This set of factors has resulted in one of the most beneficial solar tax incentive packages in the country. Since 1974, the Arizona Legislature has introduced and improved measures that provide tax incentives to individuals, builders, and commercial entities who choose to install solar devices. In 1979 provisions were made to implement a comprehensive program of significant tax incentives for installation of solar devices. During the 1980 legislative session the program was adjusted to better accommodate the needs of the solar industry and further protect consumers. These incentives are a major element in achieving Arizona's goals of, by the year 2000, meeting 25% of its energy needs through conservation and utilization of solar resources; and working toward energy self-sufficiency. By meeting these goals, we will contribute to national goals, bring some relief to the burdensome cost of non-renewable fuels, and energize the economy by creating a new major industry with jobs for Arizonians and others throughout the country.

The purpose of this paper is to note some of the results and consequences of the incentive laws package and outline some options for the future. Areas addressed are: summary of Arizona solar laws; results attributable to incentives; some observed, unsought consequences; and needs for the future.

SUMMARY OF ARIZONA SOLAR LAWS

As background for understanding the incentive program, the Arizona laws related to solar energy are summarized below. For more details you may refer to an excellent paper, "Tax Incentives for Solar Energy," by Donald Osborn, Associate Director of the Arizona Solar Energy Commission, published as part of the proceedings of the Third National Conference on

Technology for Energy Conversion, Information Transfer, Inc., 1979. Summaries and copies of the pertinent Arizona laws may be obtained from the Arizona Solar Energy Commission, 1700 West Washington, Phoenix, AZ 85007, (602) 255-3682.

Income Tax Credits

The Arizona 35% solar income tax credit can be claimed by a homeowner, builder, or commercial entity and is independent of the federal credits. The credit decreases in increments of 5% a year starting in 1984 and expires in 1989.

Residential. Arizona homeowners and home builders may claim 35% of the installed cost of a solar device, up to \$1,000. The homeowner and builder may not both take credit. Carry-over is allowed for 5 years.

Commercial. Agriculture, industry, and other commercial users of solar devices qualify for a 35% tax credit on the installed cost of solar equipment. There is no dollar limitation on the credit. Carry-over is 3 years.

Conservation. For insulation and other specified energy-conserving measures a taxpayer may claim a credit of 25% of installed cost, not to exceed \$100 for a taxable year.

Income Tax Deduction

Residential or commercial solar installations may be amortized over 36 months. This deduction may be selected by the taxpayer instead of tax credit. However, only one may be used.

Tax Exemptions

Real property. For tax purposes, solar devices installed on residential or commercial property do not increase the assessed value of the property.

Retail sales. Solar energy devices are exempt from state sales (use and transaction privilege) taxes.

Access, Zoning, Restrictions, Codes

The land-use element of a municipality's long-range general plan may include solar access.

A municipality may regulate access to incident solar energy in its zoning laws.

A municipality or county building code may require new single-family residences to be designed to facilitate future installations of solar water heaters.

A county plan, which provides for zoning, may consider access to incident solar energy.

Protections

Effective April 17, 1980, easements, restrictive covenants, or other devices which restrict utilization of solar devices are invalid. This law is not retroactive. It affects only those agreements made on or after April 17, 1980.

A manufacturer, seller, or installer of a solar energy device must give to the buyer a written statement of warranty or lack of same to entitle the buyer to be eligible for tax credits.

Installation of solar devices is limited to contractors licensed as solar contractors. This provision does not affect installations not required to be done by a licensed contractor such as homeowner installed systems.

To qualify for solar tax credits, the collectors, heat exchangers, and storage units of a solar energy device and their installation shall be fully warranted for a period of not less than two years. The remaining components and their installation shall be fully warranted for a period of not less than one year.

Beginning January 1981, to qualify for tax credit, collectors will be required to meet standards adopted by the Executive Director of the Arizona Solar Energy Commission. The Executive Director may establish standards for other solar devices as he deems necessary.

Public Buildings

Certain solar design features are mandated for new state buildings of over 6,000 square feet (effective April 17, 1980). These features must be considered in new plans:

- o proper site orientation
- o active and passive space heating
- o solar water heating
- o solar daylighting

RESULTS OBSERVED

It appears reasonable and prudent to assume that results generated from the incentives just mentioned can be measured in terms of units sold, or gross sales, and that the measures can be approximated as a linear function of the incentive program. At this time we have no mechanism for measuring sales directly, so a method of approximation based on the record of the number of tax credits applied for and the dollar amount of those credits has been devised. This method can be adjusted over time so that eventually it should become a close approximation. By utilizing tax returns as a basis and applying the approximation method, it is estimated that sales of solar devices in Arizona for 1978 and 1979 (the first two years tax incentives were available) were 2,900 and 9,000 units, as shown in Table 1. From that limited data base and discussion with industry representatives, projections for 1980, 1981, and 1985 have been developed and are included in the table.

Estimates for future year sales are made on a straight-line basis, so are considered conservative. As prices of non-renewable fuels increase and solar gains general acceptance as a viable, less expensive replacement, demand over the near term will most likely increase in a geometric, rather than linear progression.

But the bottom line is not the number of sales, or their dollar value. It is energy savings. To determine the contribution solar hot water systems are making now and what might be expected in the future, we developed figures on savings for the number of solar domestic hot water (SDHW) units estimated to be in operation over the years through 1985.

TABLE 1. Estimated Sales of Solar Devices

| | Tax Credit
Applications | Tax Credits
Claimed (\$) | Estimated
Minimum
Sales (\$M) | Estimated
Sales (\$M) (c) |
|----------------------|----------------------------|-----------------------------|-------------------------------------|------------------------------|
| 1978 | | | | |
| Homes | 2,839 | 945,468 | -- | -- |
| Builders (a) | -- | -- | -- | -- |
| Commercial (a) | -- | -- | -- | -- |
| Total | 2,839 | 945,468 | 7 | 10 |
| 1979 (As of 8/16/80) | | | | |
| Homes | 8,089 | 4,227,102 | -- | -- |
| Builders | 247 | 149,580 | -- | -- |
| Commercial | 154 | 200,813 | -- | -- |
| Total | 8,490 | 4,577,495 | 21 | 31 |
| 1980 (Estimated) | 15,000 | 8,000,000 | 38 | 56 |
| 1981 (Projected) | 21,000 | 11,000,000 | 53 | 78 |
| 1985 (Projected) | 46,000 | 20,000,000 (b) | 115 | 170 |

(a) Tax credits not available to builders and for commercial uses in 1978.

(b) Adjusted downward 10% for change in tax credit rates.

(c) These two columns show a projected range of sales in millions of dollars. They define the boundary from an estimated minimum to the estimate of expected sales.

They are shown in Table 2. The 194,000 units operating in 1985 are expected to yield an annual savings equivalent to 668.960×10^6 KWH, or 397,010 barrels of oil, or $2,283,400 \times 10^6$ BTU's. Taking Arizona's 1972 hot water requirement of 24.60 trillion BTU's as a base,* we see that the 2.28 trillion BTU's of solar contribution (solar fraction) should be 9.28% and by the year 2000 solar devices can be expected to meet a minimum of 37% of Arizona's needs for hot water.

Although this simplistic model does not include factors such as expected growth in population that will increase demand for hot water, probable geometric increase in sales of solar devices over the near term, leveling off of demand, or assumptions concerning the economic future, it is a reasonably rough estimate of the future for short-range planning. And as more data becomes available over the years, the model can be corrected to predict the future more closely from actual market data.

CONSEQUENCES

As we have just noted, the consequences of Arizona's solar incentive programs have been salutary in that they have contributed significantly to increased sales of solar devices which, in turn, have contributed to energy savings and job development. There have also been a few unsought consequences that need to be examined for possible solution.

A Desired Consequence: Increased Sales

As with any industry, solar should not depend on governmental incentives for long-term support. The industry must eventually be able to operate competitively in the open market. But to stimulate the marketplace and generate market incentives, which ensue naturally from competition, government-supported programs are desirable.

Here in Arizona we are beginning to perceive the operation of competitive market incentives. The seeds that have been so carefully planted, watered, and nurtured are now beginning to sprout. Through laws beneficial to the solar industry, the distribution of information,

*1977 Arizona Energy Flow, Office of Energy Programs, Phoenix, AZ.

TABLE 2. Savings Generated by Solar DHW Installations

Year	Units Sold	Cumulative Operating Units	KWH Savings x 106		BBL Oil Savings		BTU Savings x 106		Percentage of Total DHW Needs (a)
			Year	Cumulative	Year	Cumulative	Year	Cumulative	
1978	2,900	2,900	10.005	10.005	5,937	5,937	34,417	34,417	.14
1979	9,000	11,900	31.050	41.055	18,427	24,364	105,970	140,390	.60
1980	15,000	26,900	51.750	92.805	30,712	55,076	176,620	317,010	1.29
1981	21,000	47,900	72.450	165.260	42,997	98,073	247,270	564,280	2.30
1982	27,000	74,900	93.150	258.410	55,282	153,360	317,920	882,220	3.58
1983	33,000	107,900	113.850	372.260	67,567	220,920	388,570	1,270,800	5.17
1984	40,000	147,900	138.000	510.260	81,899	302,820	470,990	1,741,800	7.08
1985(b)	46,000	193,900	158.700	668.960	94,184	397,010	541,640	2,283,400	9.28

Assumptions: 1. The average contribution of a domestic electric water heater to an energy load is 4,600 KWH/year. (From Marketing Research Dept., Arizona Public Service Co.)
 2. On the average, a SDHW system displaces 75% of KWH requirement, or 3,450 KWH/yr.
 3. One barrel (BBL) of #2 fuel oil = 1,685 KWH.
 4. One KWH = 3,413 BTU.

(a) Based on 1972 requirement of 24.6×10^{12} BTUs to heat water in Arizona.

(b) By 1985 it is estimated there will be 194,000 SDHW systems installed in Arizona. There are presently 700,000 single-family homes in Arizona.

(c) The estimates of oil savings are conservative. If the fuel savings at the generating plant are used, the number is about 3 times larger since it requires about 10,500 BTU to generate 1 kWh.

workshops on specific solar concepts or devices, financial incentives, and plain old jawboning, the fruits of all that labor are now blossoming into what promises to be a bumper crop for the solar market.

As an example, government-funded surveys of builders and solar workshops over a three-year period have contributed to the building of five model solar homes by John F. Long. The project is supported by funding from DOE and the Arizona Solar Energy Commission. The model that has attracted most attention and captured the imagination of many is the home with a photovoltaic roof. During some periods of the day it produces all electrical power needs of the house and feeds excess power it generates back into the grid of the local utility company.

After opening that model, Mr. Long announced plans to build 100 more solar homes that will have the added feature of being able to recharge batteries of the electric cars his company's engineers are converting from standard compacts.

The considerable publicity and consequent buyer interest generated by the Long solar homes was not left unnoticed by other builders. It became suddenly obvious to builders that solar really could add a competitive edge. Within a short time another large volume builder, Estes Homes, announced plans for an experimental house that will feature a hydrogen generator powered by a photovoltaic roof. The hydrogen generator is to be used to power the home and also recharge the tanks of a hydrogen car and helicopter.

Just one week later another major builder put a two-page centerfold ad in the Phoenix Sunday paper headlined "Introducing standard solar water heaters." Part of the ad read:

Continental Homes is proud to announce a first. Solar water heaters are now a standard feature on every home we build.* According to the Arizona Solar Energy Commission, an average family of four will save from \$208 to \$260 a year with solar water heating versus a comparable electric hot water heater. And in addition to the annual savings, you'll get 75% of the value of the solar water heating system refunded in the form of a direct income tax credit. A credit of more than \$1,300.

*Applies to homes started after August 24, 1980.

The heat of competitive incentives is beginning to take hold. Within a week's time, Encore Homes took out a full-page ad devoted to energy-saving devices built into its homes in Sun City West. The ad was headlined "Encore Homes gives you energy efficiency at no extra cost." A principal ad segment was titled "Encore Homes feature the Solarcraft domestic water heating system at no extra cost." And now other ads with similar messages are beginning to appear frequently.

All the groundwork made possible through governmental incentive programs is finally beginning to pay off. Those programs allowed the planting of solar "seeds" through information pieces, "watering" the seeds with workshops on how to install solar, adding credibility by examples from others who are successful, and providing assurance through demonstration projects. Now the market incentive factors are working in combination with federal and state tax credit incentives to build a market segment of homes equipped with energy-saving devices as standard equipment. That's the payoff which we are just now beginning to see and the work has been worth the results.

Unsought Consequences

Exclusion of the Low Income Market Segment. Tax incentives are very nice for those who incur a tax liability, but for those who don't, there is certainly no incentive to purchase a new \$2,500 water heater. Many fall into this category and, ironically, they are those who need most to reduce utility bills. Answers are being sought on how to handle this problem that affects a very large segment of the potential market. Possible responses might include a tax rebate or low, no interest loans for persons with low incomes.

Solar companies raise prices. It has become apparent that some solar retailers have inflated prices to allow them to compensate the customer artificially by offering a rebate, or other monetary reward, for purchasing a solar DHW system. These monetary incentives, in addition to state and federal tax credits, can make SDHW systems very attractive on an initial cost basis. For example, if one were to buy a solar water heater for \$3,000 installed, and the dealer offers a \$500 incentive of a type

that does not affect the sales price for tax purposes, the numbers could look like this:

Sales Price	\$3,000
Less: Dealer Incentive	500
State Tax Credit (35%)	1,000
Federal Tax Credit (40%)	1,200
NET COST	\$ 300

This net cost can compete favorably with many installed electric water heaters, especially if one considers the appreciation in real property value usually associated with an installed SDHW system. Some techniques that are presently being practiced are: direct rebates, payments of monthly utility bills, and payments for allowing the seller's advertising sign to be placed on the buyer's property. Of course, if the customer does not want to participate in these money-back offers, he pays full price and the company makes an extra profit.

There are some hidden problems with dealer incentive plans. Most buyers are not aware that when they accept incentives they must include full value of the incentives as income on their annual federal and state tax returns. They must also use the net cost (sales price less full value of incentive) as a basis for computing tax credits. The industry has recently been made aware of those facts by letter from the Commission.

FUTURE NEEDS

Broaden Market

As mentioned above, some measures need to be taken to broaden the market segment that is capable of purchasing SDHW systems. Specifically, a plan should be developed to allow lower middle and lower income families to take advantage of the operating economics of solar DHW systems.

SDHW as Standard in New Homes

Continued efforts need be made to convince more builders that SDHW should be standard in new homes. Most builders will sell what's selling, so they wait to see whether SDHW's help or hinder sales of others' houses before they commit themselves. The bold moves made by John F. Long, Estes, Continental, Encore, and others are fostering the idea of a fuller

commitment to solar. But again, the problem of low income families who have little or no tax liability becomes significant. Few people want to pay \$2,500 for a water heater if \$200 first cost will do the same job. And many feel they will not live in the house long enough to pay off the added initial dollars on mortgage through savings in utility bills. This is a marketing and practical financial problem which may be solved, at least to some degree, by the Energy Conservation and Solar Bank.

Photovoltaic Devices

The solar tax credits were set up with SDWH and space heating systems in mind. There was a deliberate phase-out of the credits set up in the law. However, photovoltaics offer the potential of being economically attractive in the mid 1980s and possibly providing substantial energy savings. Consideration of extending the tax credit system should begin now to allow full development of the photovoltaic potential.

Solar Access

A legislative package is being prepared which, when passed, will address the problem of appropriate solar access for structures to be built in the future.

CONCLUSION

Arizona's solar incentive program has given the industry an opportunity to introduce hardware at an attractive price to persons who have sufficient tax liability to take advantage of the tax credits offered. This incentive program has planted the seeds of solar attitudes in neighborhoods where individuals have installed solar DHW systems. The seeds are germinating and it appears the demand for solar DHW systems is increasing. As it increases there should be an awareness of the need to expand to other segments of the relatively untapped market segments and to maintain a high sense of moral and professional responsibility within the industry. With all those factors working in concord the goal to achieve 25% solar fraction by the year 2000 can be met.

GOVERNMENT REQUIREMENTS IN SOLAR DEVELOPMENT

H. Richard Chew

I have been asked to comment on the "requirements" aspect of the Battelle Analysis. I shall be crossing freely the line between state and federal actions as I touch upon access and consumer protection.

As we review the history of governmental actions affecting the price and production of resources, as treated in the Analysis, we see that they have no immediate analogue in solar. Incentives in solar generally go to the utilization of the resource rather than to its production.

An exception is access. A great deal of academic rhapsodizing has gone on about access rights, most of it rather desperate. The truth is that we do not have a public right to sunlight in this country and, under our present Constitution, never will. Moreover, no economic model will exist in support of defoliation or other technologies for the reduction of shade; nor will they for the dispersal of clouds, or the reduction of night. Access to sunlight will, especially in passive, always mean space--and the acquisition, or preservation, of access by private arrangement will cost money. The greater the space need, the greater the cost. The poor will not use solar energy. One well thought-out study states the following:

The achievement of a twenty percent solar goal within twenty years will be extremely difficult and extremely expensive and will require a massive effort by all sectors of society and all levels of government. The capital required to accelerate solar use from the present level of 22 quads by 2000 will total a minimum of one trillion dollars. . . . Achieving a twenty percent solar goal implies that in the year 2000 every second commercial and residential building in the U.S. must utilize a solar energy system and that a minimum of one of every seven U.S. factories in existence must utilize solar industrial process heat.

Through some Wirtschaftswunder we may be able to scrape up a trillion dollars, and there might be enough fat to cover the cost of administering a requirements program on the federal and state levels, but it is a physical and economic fact that every second house in the United States will not, now or ever, accommodate a solar installation. For these reasons, and others, our stated twenty percent goal is a phantasm.

We had best turn our attention to incentives bearing on reality: taxation; loans, grants, and subsidies; utility rate-base requirements; and the imposition of standards, certification, and warranty requirements.

I have chosen the latter as a point of focus. (I shall be talking about active collection, but the implications for passive will be clear.)

The contemporary solar industry is young, and problems stemming from inexperience are bound to arise, as are the fraud and misrepresentation nearly always encountered in or by new industries. These problems are compounded by the scarcity of standards for construction and performance of the solar unit. The major concern is whether the collector will have the efficiency and life expectancy promised by its purveyor. Some manufacturers have not yet settled on a final collector design and some periodically change materials. Coatings are experiencing steady technological advance, but there have been difficulties with some. Some collectors have plastic components, which degrade in ultraviolet light. Some have soft-solder joints that are unable to withstand the temperature cycling of collectors or the high temperatures (300-400 degrees F) reached.

Other design factors, such as stress arising from expansion and contraction of different materials, require that solar units, though basically simple, be fabricated with care and skill. So do functional considerations. Mismatched components will reduce efficiency. System-wide harmony is essential. For example, a mid-sized pump will lead to poor heat transfer from the collector to circulating fluid. Too large a storage tank relative to collector size will keep water too cool to be useful. If the tank is too small, the water will be too hot, diminishing collector efficiency. It is important to match collector and tank size.

There is another kind of mismatching in that components vary in their expected useful lives, with valves and pumps being culprits on the short side. They may have a useful life of a third or less of the life of the system as a whole.

A number of states have passed legislation regarding standards. California has authorized minimum standards for testing, inspection, certification, sizing, and installation, as have Connecticut and Florida.

Minnesota has authorized rules concerning quality and performance standards to be incorporated into the state building code. New Mexico has also authorized solar equipment performance standards.

Considerable protection is afforded by warranties on the system and its components. But many manufacturers and suppliers are small and new and cannot afford, or do not choose, to warrant their products. Others simply copy the warranties they have seen on conventional heating and cooling units. In any event, there are bound to be instances where the product does not perform and the owner must seek legal remedies.

The generally applicable law in this area consists of the Uniform Commercial Code (adopted with minor modifications by virtually all states). Under it there is an implied warranty of merchantability--that is, that the goods will pass without objection, in the trade, as what they are described to be and that they are fit for the ordinary purposes for which such goods are used.

Express warranties can arise if the seller makes an affirmation of fact about his product or shows a sample or model to the buyer. If these actions on the part of the seller become part of the "basis of the bargain" between the parties, then the seller warrants that the goods will conform to that description or affirmation.

If a written warranty comes with the system or with any of its components, federal law provides additional consumer protection in the form of the Magnuson-Moss Warranty Act. This law sketches out minimum standards for warranties, distinguishes a full warranty from a limited one, and provides a statutory basis for civil suits by consumers for breach of warranty. (It does not require warranties.)

The home building industry has established a voluntary warranty plan for builders, known as Homeowners Warranty (HOW). This program provides, among other things, a warranty for new home buyers that protects against structural defects for ten years and against defects in piping, wiring, etc., for two years. The purchaser of a new solar home might be covered by HOW.

The Department of Housing and Urban Development (HUD), in administering its grant program for solar demonstration projects, has undertaken an examination of the warranties provided by participating manufacturers and installers. It found that nearly all these warranties failed to meet legal requirements. HUD therefore decided to set minimum warranty standards that future project participants had to meet. The standards for installers included a one-year warranty against failure of the system or a component part from defects in material, manufacture, or installation, running from the date of installation. This included full cost of parts and labor, as well as on-site replacement. The required manufacturer's warranty included a five-year warranty against defects in material or manufacturing (including on-site replacement) on the collector, absorber plate, and coolant passages.

Even these requirements appear at this juncture to be inadequate. Installations under the Solar Heating and Cooling Demonstration Program are already experiencing unexpected problems with both design and function.

There is some indication that the Federal Government may use these standards as a basis for its own requirements in the solar equipment warranty area, and that performance standards and labeling requirements may be promulgated.

(Other consumer protection acts could bear on a solar purchase: The Fair Packaging and Labeling Act, Truth in Lending Act, Fair Credit Reporting Act, Fair Credit Billing Act, Equal Credit Opportunity Act, and the Consumer Leasing Act of 1976.)

As a state example I might mention California, which has issued interim guidelines for tax credit eligibility for equipment. They include: one-year full warranty on system and installation; three-year warranty on large components; three-year corrosion warranty; and provision by the manufacturer of instructions to the installer on compatibility of components.

Developing solar information, testing and certification, and contractor license programs will greatly reduce the danger of consumer fraud in the solar marketplace. But at a price. And the administration

of state and federal laws regarding standards, certification, labeling, warranties, and the like, will be expensive. So will the diversion of governmental labor in enforcement and litigation.

We have some experience on the administrative side. California, for instance, has found that not only its Energy Department, but also its Consumer Affairs Office and Business and Transportation Agency are involved. Test law suits are in the offing where non-complying manufacturers run afoul of the law, and this brings in the state Department of Justice.

But public cost is only a part of the picture. To the manufacturer (and purveyor) there will be an increased cost not only directly for compliance but indirectly for meeting claims. And someone will be paying us lawyers in the civil and criminal actions arising out of breaches of established standards and warranties.

What we see, therefore, is that in addition to the trillion dollars of required capital, we have unquantified costs of access siting and space requirements plus those of mandated consumer protection.

A next step should be the projection of administrative and compliance costs in the requirements area, including the items above but also emphasizing taxation and other fiscal incentives, as well as the economic consequences of utility rate-base adjustments.

A NEW FEDERALISM: THE EMERGING FEDERAL ROLE IN SUPPORT
OF STATE AND LOCAL EFFORTS TO ENCOURAGE ENERGY
CONSERVATION AND SOLAR ENERGY

Jeffrey R. Hammarlund

Events over the past several years dramatically illustrate many of the weaknesses and pitfalls inherent in pursuing any national policy without the full participation of state governments and local municipalities. Nowhere is this more true than in energy, especially efforts to promote energy conservation and the use of renewable resources. Washington can do much in the areas of research and development support, demonstration programs, tax credits, loan subsidies, the development of building energy performance standards and the like. But the Federal Government cannot effectively mandate the millions of decentralized activities and actions that are necessary to actually make solar energy and energy conservation major components of our national energy mix. For this, we need the help of both a market that is not artificially weighted in support of the use of conventional fuels and the commitment of state and local governments to develop strategies to remove the institutional and regulatory barriers that serve to inhibit solar and conservation use.

Some excellent state and local programs to support conservation and renewable resource development have now emerged with and without federal assistance. Every state has established an energy office with DOE assistance and over 400 communities have organized energy coordinating agencies. However, too many state and local governments are not able to make the contribution that they would like to make. All have suffered to some degree from: (1) lack of knowledge and experience in addressing energy issues; (2) inadequately trained technical personnel; (3) the absence of models and demonstrations of successful strategies, methodologies, and tools, and (4) limited financial resources.

Most of the existing federal assistance programs in this policy area were passed by the Congress in response to emergencies, particularly price gyrations and supply descriptions of 1973-74. They do not necessarily represent a coherent framework for achieving national energy goals, including solar goals. Instead, the programs were developed in the pressure cooker atmosphere of the energy crisis, where there was little opportunity for extensive research and program planning.

This early legislation--most notably portions of the Energy Conservation and Production Act (ECPA), the Energy Policy and Conservation Act (EPCA), and the Energy Extension Service Act--focused on establishing a set of energy conservation programs and capabilities at the state level. Solar initiatives were not emphasized. Nor was DOE authorized to establish a nationwide assistance program to local governments. Thus, while such local energy demonstration programs such as DOE's Comprehensive Community Energy Management Program (which supports capacity building for energy management in communities) and the Solar Cities Program have made significant contributions, most local governments have not received federal support.

It has now become clear that if our national effort to reduce consumption of foreign oil and to encourage a transition to renewable resources is to succeed, we must build a framework for a mutually supportive energy partnership among all levels of government. With these objectives in mind, the Administration has proposed the Energy Management Partnership Act or "EMPA." EMPA builds on the important energy conservation initiatives established under EPCA, ECPA, and the Energy Extension Service legislation; but it also goes much further in a number of important respects.

The State Role

With regard to the states, EMPA can provide assistance in the following ways. First, EMPA encourages states that do not already have an effective energy management capability to develop their own overall energy supply and conservation plan in cooperation with local governments. EMPA funds states to develop and implement comprehensive state energy plans that would address all aspects of their energy situation, while still

allowing for considerable flexibility as to how each state, with its unique set of opportunities, resources and constraints, might best respond to meet its energy responsibilities. This would not only strengthen each states' energy planning and management capabilities, it would assist the Federal Government by providing a valuable "bottom up" view of the energy profile of each state and region in the country.

Second, EMPA consolidates and simplifies administrative procedures for the three core grant programs--the EPCA and ECPA State Energy Conservation Programs and the Energy Extension Service. It also permits states to consolidate applications for other assistance programs administered by DOE and provides states with greater flexibility in the use of federal funds under such programs. By cutting red tape and giving states greater flexibility to tailor programs to meet their needs, more money will be available for implementing energy programs, and less will be required for grant administration.

Third, EMPA includes strong evaluation and technical assistance and training components for both the state and local programs to ensure that federal funds are well spent and that the lessons learned from these programs reach a wide audience.

Fourth, and of particular interest to the participants of this workshop, EMPA demonstrates a recognition that states and local governments are key partners in the effort to reach the national goal of 20% solar use by the year 2000. States would receive EMPA funds to develop as a part of their comprehensive energy plan a set of strategies to remove certain institutional barriers to the use of renewable resource that were identified in the President's Solar Domestic Policy Review of 1978-79. The state plan must include measures to:

1. encourage the application, where practicable, of renewable resources in end-use sectors;
2. encourage participation by financial institutions and other organizations in the activities necessary to facilitate renewable resource use;
3. assess the applicability of practicable renewable resource technologies in buildings and facilities owned by the state and units of local government;

4. provide for intervention by the state and others in electrical and gas utility regulatory proceedings, to ensure that any proposed regulatory decision does not discriminate unfairly against the use of renewable resources;
5. provide information that will promote consumer protection; and
6. implement other programs that the state determines to be appropriate.

EMPA authorizes \$105 million per year for five years to assist the states in the activities described above.

Local Government

The cooperative framework that we envision would not be complete without full participation of local governments--from the stage of developing the state energy plan through its implementation. Even under the existing state programs, some states have voluntarily taken advantage of the capabilities of local governments to achieve energy conservation.

The advances made by local governmental pioneers in energy conservation such as Davis, Portland, and Seattle, are by now well known. But many other cities and counties have also undertaken successful efforts to improve community energy efficiency, both with and without "seed money" from Washington. Two illustrations would be useful. Oakland's conversion of streetlights to energy-efficient high-pressure sodium lamps saves over 30,000 barrels of oil and \$900,000 a year. Nassau County, New York, uses computers to carefully monitor energy use in governmental buildings, which has reduced consumption by 20 - 25%.

The Administration now considers a state/local energy partnership to be an essential ingredient of the institutional structure the United States should use to manage its energy affairs creatively and effectively. Thus, EMPA formally recognizes an expanded energy role for local governments. The legislation encourages such an expanded role in four key ways:

- o EMPA provides for local governmental participation in the development and review of the energy plan;

- o EMPA allows local governments to share the states' allocation of funds in proportion to their responsibilities under the comprehensive state energy plan;
- o EMPA authorizes DOE to provide technical assistance, training and information services to local governments and regional councils upon request; and
- o EMPA authorizes DOE to provide grants to local governments and regional councils on a competitive basis to support energy conservation and renewable resource planning and programs.

EMPA authorizes \$50 million yearly for five years for the competitive grants program and technical assistance to local governments and regional councils.

EMPA recognizes the value of giving the local governments themselves the lead in designing and implementing a local energy conservation and renewable resource strategy that is tailored to the unique set of needs, opportunities, constraints, culture, and goals of each locality. DOE will provide technical assistance on request, but will not attempt to determine the direction of the local strategy itself so long as the proposal meets the general selection criteria.

Priority funding will be given to those local governments and regional councils that have demonstrated a commitment to:

- o conservation and the increased use of renewable resources;
- o the coordination of local planning initiatives with the planning activities of appropriate state government and federal agencies (such as HUD, DOE, Commerce);

and which submit proposals that:

- o are consistent with the overall state conservation and renewable resource strategy as expressed in the state energy plan;
- o present the greatest opportunity for conservation or the increased use of renewable resources; and
- o appear to be applicable to other units of local government or regional councils.

As I previously noted, EMPA would authorize DOE to provide technical assistance and information services to local governments and regional

councils through a variety of mechanisms. This may include technical assistance teams in each region that would be available upon request, and a training institute to provide intensive instructions to interested local officials.

This assistance would also include an information clearinghouse to support lateral communication among local and state energy officials, with up-to-date information on (and lessons learned from) locally based energy conservation and renewable resource development efforts. Such a clearinghouse--the President's Clearinghouse on Community Energy Efficiency--was established as a pilot program last summer at the President's request. It is staffed largely by local energy officials themselves who have agreed to come to Washington for four to six week periods. Not only have these local officials provided a timely information service to their colleagues in other communities, we have also been pleased with a valuable exchange of information that has taken place between these local officials and their counterparts within DOE. In short, we have found the clearinghouse to be a successful experiment that deserves to be continued.

To complement the clearinghouse concept, EMPA provides for small grants to local governments (and their national associations) that have already developed innovative energy programs. Localities receiving these grants would prepare and publish practical brochures on the strategies that they have undertaken, and would make this information available free of charge to other localities.

DOE supports and encourages complementary efforts by other federal agencies to augment EMPA funding by channeling portions of their financial assistance to support local energy conservation and renewable resource activities. In fact, this is one application of the concept embodied in the President's Executive Order 12185 that was issued earlier this year. In particular, DOE intends to cooperate with HUD to develop initiatives to encourage the use of the Community Development Block Grant and the Urban Development Action Grant funds for conservation and renewable resource planning, programs, and capital projects.

SOLAR ENERGY AND THE SEARCH FOR EMISSION OFFSETS: A PROPOSAL*

Kevin M. O'Brien and Barbara Euser

Before a major air-polluting plant may be built or expanded in an area that does not comply with national air quality standards, emission of air pollutants by existing plants in the area must be reduced. This is generally done in a procedure known as "offsetting"--trading emissions from the new or expanded plant for emissions from existing sources.

Solar energy may be useful both in providing offsets and in reducing the pollution of new or expanded sources enough to avoid altogether the need to go through offsetting process. Although it is relatively expensive now for the most common industrial application, industrial process heat (IPH) solar energy may be attractive to some industries, especially in the long term, when compared in cost with the combination of conventional energy production and pollution control equipment.

INTRODUCTION

Before General Motors could build a long-planned Oklahoma City assembly plant, a search was undertaken to identify industrial polluters in the area. This search revealed a serious air pollution problem: the local oil companies used fixed roof instead of floating roof petroleum storage tanks, resulting in the discharge of thousands of tons of hydrocarbons per year. The Oklahoma City Chamber of Commerce persuaded the oil companies to install floating roofs on the storage tanks, thereby reducing the pollution they caused, and construction of the assembly plant was allowed to proceed.

The inducement for this activity was a legal one: the requirements of the 1977 Clean Air Act Amendments. Section 129 of the 1977 Amendments provides that, before a company may construct a major polluting plant in

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an area that has not met any of five national ambient air quality standards (NAAQS)--a nonattainment area--it must reduce air pollution in the area by more than the amount the new plant will add. This procedure is called "offsetting." By reducing hydrocarbon emissions by 5,316 tons per year, GM was able to offset the air pollution of its new plant, projected to be 3,340 tons per year. As a result, the automaker obtained the necessary preconstruction permit.

The offset policy, a creation of the Environmental Protection Agency (EPA), gives industry the opportunity to develop its own plans for meeting clean air requirements. The policy has dispelled earlier fears that the Clean Air Act would ban industrial growth in nonattainment areas. As the states take over responsibility for meeting the air quality standards from the EPA, indications are that most will continue the offset approach in some form.

Our focus is on solar energy as an alternative means of offsetting. Because solar energy is nonpolluting, any reduction in emissions that results from the installation of solar devices can, in theory at least, be offset against the pollution from conventional energy sources. This alternative will be particularly useful where the pool of available offset candidates may have been all but exhausted or where easily--and cheaply--obtained emissions offsets may be in short supply. We will examine the legal and economic issues raised by such a proposal.

OVERVIEW OF THE OFFSET POLICY

Framework of the Clean Air Act

A detailed explanation of the Clean Air Act is beyond the scope of this article. Briefly, national ambient air quality standards (NAAQS) are set by the EPA; and the states develop plans, approved by the EPA, to implement the standards. The country is divided into 247 air quality regions. A region may be in compliance with the NAAQS for some pollutants and not for others. Construction or modification of major sources of air pollution depends on permits granted after review. In regions that meet the standard for a particular pollutant, review is for "prevention of significant deterioration" (PSD). The purpose of PSD review is to allow

industrial expansion in those areas without degrading the quality of their air. In nonattainment areas, the purpose of the review is to allow growth while assuring compliance with plans to achieve the standard.

Primary responsibility for implementing the Clean Air Act rests with the states. The Act directs state agencies to develop and adopt state implementation plans (SIPs) by setting forth control measures sufficient to achieve compliance with the NAAQS standards.

Background of the Offset Policy

The offset policy arose in connection with the EPA's implementation of rules governing preconstruction review of new or modified sources in nonattainment areas. In applying these regulations, the EPA found itself in a political dilemma. On the one hand, the Clean Air Act, as interpreted by the courts, "subordinate(d) demands for industrial expansion to the need for attaining and maintaining clean air." On the other hand, economic stagnation seemed to many an intolerably high price to pay for clean air.

The offset policy emerged as an attempt to reconcile these conflicting demands. As one commentator put it: "The essence of the Offset Policy is that major new growth should be allowed in nonattainment areas only if air quality is improved as a result of that growth."

Originally set forth in an EPA interpretative ruling, the offset policy allowed construction of major new sources of pollution and modification of major existing sources in nonattainment areas where greater than one-for-one emission offsets were achieved.

The premise underlying the policy, one commentator writes, "is that even where severe abatement measures have already been required, untapped opportunities exist for further emission reductions." Offsets, then, "must represent emission reductions that otherwise would not be required."

The offset concept was incorporated with changes, into Section 129 of the 1977 Clean Air Act Amendments. On January 16, 1979, the EPA revised the original interpretative ruling; and, in September 1979, the agency proposed additional changes.

Response to the offset policy has been generally positive. The program encourages innovation and economic efficiency on the part of industry, adding flexibility to the seemingly rigid commands of the Clean Air Act and allowing industrial growth.

Scope of the Offset Policy

Sources subject to nonattainment review are "major" stationary sources of air pollution--those "which directly emit, or (have) the potential to emit, one hundred tons per year or more of any air pollutant," after accounting for any air pollution control equipment that may be used. If a modification of a source of this size increases emissions at all, the modification is subject to review. The EPA may, however, exempt increases which are too small for the agency to be able to regulate or which are de minimis, that is, of inconsequential size.

Sources covered by the offset policy are those emitting particulates, sulfur dioxide (SO_2), nitrogen oxide (NO_x), volatile organic compounds (hydrocarbons which produce ozone), or carbon monoxide.

The EPA regulations limit emission offsets to those of the same type, that is, "intrapollutant" emission offsets. If a new source will emit, for example, hydrocarbons, it will have to find offsets in existing sources that also emit hydrocarbons.

This limitation may be a serious barrier to solar offsetting. If, for example, solar power is offset against emissions from coal-fired industrial boilers, offsets would be limited to sulfur dioxide and particulates, the major byproducts of coal burning. Accordingly, only proposed new or modified plants that would emit these pollutants could take advantage of solar offsets.

The EPA has been criticized for its refusal to allow interpollutant offsets, a policy apparently based on the difficulty of comparing pollutants. The limitation may be moderated as the states assume responsibility for administering the program under the revised implementation plans. This will not, of course, be an issue in those regions that are nonattainment areas for only one NAAQS.

Sufficient offsets must be obtained from existing sources in the area of the proposed source to provide a "positive net air quality benefit" in

the affected area. This test is intended to ensure that, on balance, an air quality benefit is achieved in the general area affected by the new source. Whether this presents an additional requirement above the net reduction in emissions is not clear, but an offset for a new (or modified) source may be required to be fairly close to the new source--the EPA is using a rule of thumb of 5 miles--or the required ratio of offsets may increase as the offsetting is done further away from the new source.

Offsetting under State Implementation Plans

The 1977 Amendments require the states to revise their implementation plans for nonattainment areas. While these state implementation plans were to have been approved by the EPA by July 1, 1979, few plans have yet been approved. Where there is no revised plan conforming to the 1977 Amendments, the Act imposes a ban on construction or modification of major new sources within the nonattainment area.

Whenever it is filed and approved, a SIP becomes the governing law for all existing sources within the nonattainment area and all new or modified sources affecting the area. That is, the state takes over the problem of growth in nonattainment areas. States have a choice of retaining the offset approach or of reducing emissions far enough below the standard to allow for growth without case-by-case offsets. If the growth allowance is used up or if none is created, the state may issue permits only by using case-by-case offsets.

Will the states continue using the offset approach? It will be difficult for states to reduce emissions enough to make room for growth, so it seems likely that the offset approach will remain in frequent use. Solar energy can play a role both in the expansion of state offset programs and in the creation of growth allowance margins.

The "Bubble"

Related to offsetting is the "bubble" concept, used in the PSD procedure. The bubble functions like an offset: reduced emissions in one source at a plant or even at other plants are traded for emissions at the new or modified source. The original idea behind the bubble was to treat the various buildings which make up an industrial plant as a single

source, as if all their smokestacks were under a giant bubble with one outlet. Offsetting increases and decreases in emissions from various plant components entail no regulatory consequences. The bubble concept allows a manufacturer to select the most cost-effective mix of control technology.

Although the EPA has never included the bubble in its offset policy, it has advised the states that they may use the concept in their revised SIPs for areas which are expected to attain the air quality standards by 1982.

A SOLAR OFFSET PROGRAM

Solar energy has potential applications in any pollution control program, but its most promising use would seem to be in nonattainment areas. It is in those areas that new and modified sources are likely to be most stringently controlled; hence very expensive pollution control may be needed, boosting the value of solar energy as a substitute.

Offset Possibilities

The first offset possibility, when the new source is an expansion of an existing plant, is, as Quarles points out, an internal offset: the manufacturer installs tighter controls on existing operations. This might include use of innovative technology or controls "so costly that they would not normally be required."

A new or modified source might alternatively "strike a deal with another large industrial plant in the area to apply extra pollution control measures, presumably with a sum of money changing hands." "(A)n applicant may simply purchase an existing facility in order to clean it up or close it down, particularly an old, obsolete plant with large pollutant emissions." A market for pollution rights may develop. In fact, however, almost all offsets have been internal, that is, intraplant.

In any of these instances, solar energy could be substituted for pollution controls. In the last instance, its use could avoid the possibility that construction of a new plant would cause a net decrease in jobs by avoiding the closing of an existing plant. Solar installations

could be used to reduce emissions from new or modified sources, thus reducing or avoiding the need for offsetting altogether, particularly if the bubble concept were adopted in a SIP.

Substituting nonpolluting solar energy for polluting fuel-burning will result in a net decrease in emissions, represented by the following formula:

$$\frac{\text{Emissions (tons)}}{\text{Energy Produced}} \times \text{Net Decrease in Energy Production} = \text{Emission Offset Credit (tons)}$$

Solar Energy Applications

Solar collectors could be placed on individual residences to offset oil-burning or powerplant emissions, although administrative difficulties are likely to limit this application. Providing solar heating or cooling for office complexes or entire industrial parks is likely to be more practical and could produce more easily measurable offsets. In fact, however, the use of solar energy for industrial process heat (IPH) is likely to be the most frequent application for offsetting.

The Economics of Offsetting

Two sets of cost information must be considered in determining the economic feasibility of a solar offset program: the cost of pollution control plus conventional energy production on one side and the cost of converting the sun's energy to use on the other.

A comparison of estimates of the cost of controlling the final 10% of emissions, plus conventional IPH, with the cost of solar IPH, is set forth in Table 1. This is a hypothetical case rather than an example of the costs involved. Figure 1 illustrates some of the assumptions in Table 1. Figure 2 shows that the marginal cost of cleaning up the last 10% or so of emissions increases sharply.

As noted, Table 1 assumes a single, daylight shift; conventional backup equipment is needed, although seldom used, producing negligible fuel costs but no saving on capital. That is, the conventional energy production equipment is installed with both systems. The only difference in capital costs between the two systems is for pollution control

TABLE 1. Hypothetical Cost of Added Pollution Controls Versus Adding Solar Industrial Process Heat

| Thermal Power Plant
200 MW | Capital Cost
(\$/kW _t) | Operating and Maintenance Cost
(O + M)
(\$/kWht) | Levelized Cost
$\frac{\text{Capital Cost} \times 0.10}{\text{Annual Output}} + O + M(c)$
(\$/kWht) | Energy Cost
(\$/kWht) | Total Plant Operating Costs
(\$/kWht)(f) |
|---|--|--|--|--------------------------|---|
| Pollution Controls
(SO ₂)(a) | 90 | 0.55 | 0.86 | 3.0(d) | 3.86(g) |
| Solar Energy | Near Term - 3,000(b)
Long Term - 1,000(b) | 0.10
0.10 | 10.27
3.52 | 0(e)
0(e) | 10.37
3.52 |

(a) Limestone scrubbing;

(b) Assume no saving on cost of capital of conventional energy production system, used as occasional backup for solar system;

(c) Assume 10% fixed charge rate (FCR); annual output = 584,000,000 kWht, based on a single, daytime shift;

(d) 3¢/kWht = \$8.78/MBtu, equivalent to purchase price of \$44/bbl of oil where oil is used at 80% conversion efficiency;

(e) Assume output of solar system is 584,000,000 kWht; additional fuel costs to match conventional output then near zero;

(f) Calculations done on before-tax basis; i.e., no allowance made for deductibility of fuel cost as an operating expense nor for 20% investment tax credit on industrial installation of solar equipment.

(g) Total plant operating costs = levelized cost of pollution control + energy cost.

Figure 1. A Comparison of Estimates of the Cost of Controlling the Final 10% of Emissions.

Graph—Adapted from D. N. Dewees, C. K. Everson, W. A. Sims, *Economic Analysis of Environmental Policies* (Univ. of Toronto Press, 1975).

Figure 2. The Increase of the Marginal Cost.

equipment in one system and solar equipment in the other. Much of major industry works two or three shifts or uses processes that run around the clock, reducing the likely role of solar energy for IPH to 30-40% at best in these industries. But there are many plants, mostly small and medium size, that run only one shift of 8 or 10 hours, five or six days a week. In such plants, with the proper amount of solar radiation, use of conventional backup power would be expected to be very infrequent. A further assumption is made: that pollution controls are not required for very intermittent use of conventional backup for the solar energy system.

Assuming a certain level of control has been established by virtually all the large plants in a given nonattainment area (90% in this example), the cost of installing additional control devices for the purpose of obtaining offsets would be disproportionately high. We hypothesize that, at some point in that final increment (Point A in Figure 2), investment in solar energy as an alternative offsetting technique will become cost-competitive in the long term.

The Economics of Solar Industrial Applications

Industry is the largest energy user in the United States, consuming about 37% of the energy used. It is estimated that about 50% of industrial demand is for industrial process heat (IPH), thermal energy used in manufacturing processes.

Although solar thermal energy can be supplied at almost any temperature required by industry, it is now produced most cost-effectively at temperatures of less than 550F for higher temperature requirements, about half of IPH demand is at or below 550F. Commercially available solar equipment is now capable of operating at temperatures up to 550F. Like conventional process heat, solar IPH can be supplied directly or through a heat transfer fluid such as hot water; hot, dry air; heat transfer oil; or low-pressure steam.

There are many potential applications for solar energy in industry. Solar energy may be used to preheat water for oil-fired boilers producing steam. It may be used to heat water used directly in industrial processes, as in food processing or textile dyeing, possibly offsetting

emissions from oil or coal. Solar energy may be used to dry foods such as onions, garlic, raisins, and prunes, replacing natural gas or oil.

Table 2 lists several projects underway to test the feasibility of solar IPH. These projects have demonstrated benefits which will be of increasing importance to industrial management. In addition to pollution control, they include: (1) alleviation of costly plant shutdowns resulting from fuel supply interruptions, (2) avoidance of rapidly rising construction costs resulting partly from pollution control requirements, (3) avoidance of rapidly escalating fuel costs, and (4) public relations benefits resulting from reduction of air pollution and conservation of nonrenewable energy resources.

Solar IPH is not now economically feasible when compared with less expensive alternatives such as coal, oil, or natural gas. When, however, the cost of pollution control equipment for the last increments of control is added to the cost of conventional process heat production, solar energy will likely be competitive in the long term for some applications. Given the massive size of the IPH energy demand, estimated as 10.60 quads in 1978, even a small portion of this demand is substantial.

As suggested by Figure 2, the cost of cleaning up the final 10% increment is likely to be double or even triple previous unit costs. This is precisely the situation that will confront industrial managers in many nonattainment areas: adding to pollution control at a prohibitive price.

As shown in Table 1, it is estimated that additional research and development and the introduction of mass production techniques will reduce the cost of solar industrial systems markedly, perhaps by as much as 50%. Similarly, changes in tax policy may create significant incentives. At present, fuel costs can be deducted from taxable income, while solar energy, because it is not explicitly "purchased," does not qualify as a tax deductible expense. Changing the tax laws to provide a deduction for fuel saved or to permit accelerated depreciation could bring solar energy costs closer to the combined cost of pollution control and energy.

The upshot is that solar energy, while not presently an economic alternative to pollution control equipment, may become so in the future.

TABLE 2. Solar IPH Field Tests

Location	Process	Collectors	Owner	Status
<u>Hot Water (140°-212°F)</u>				
Sacramento, California	can washing	flat-plate & parabolic trough	Campbell Soup Co.	operational (April 1978)
Harrisburg, Pennsylvania	concrete block curing	multiple reflector	York Building Products	operational (Sept. 1978)
LaFrance, South Carolina	textile dyeing	evacuated tube	Riegel Texture Corp.	operational (June 1978)
<u>Hot Air (140°-212°F)</u>				
Fresno, California	fruit drying	flat-plate	Lamanuzzi & Pantaleo Foods	operational (May 1978)
Canton, Mississippi	kiln drying of lumber	flat-plate	LaCour Kiln Services, Inc.	operational (Nov. 1977)
Decatur, Alabama	soybean drying	flat-plate	Gold Kist, Inc.	operational (May 1978)
Gilroy, California	onion drying	evacuated tube	Gilroy Foods, Inc.	operational (Sept. 1978)
<u>Low Temperature Steam (212°-350°F)</u>				
Fairfax, Alabama	fabric drying	parabolic trough	West Point Pepperell	operational (Sept. 1978)
Sherman, Texas	gauze bleaching	parabolic trough	Johnson & Johnson	operational (Nov. 1979)
Pasadena, California	laundry	parabolic trough	Home Cleaning & Laundry	construction
Bradenton, Florida	orange juice pasteurization	evacuated tube	Tropicana Products, Inc.	construction
<u>Intermediate Temperature Steam (350°-550°F)</u>				
Mobile, Alabama	oil heating	parabolic trough	Ergon, Inc.	design only
Dalton, Georgia	latex production	multiple reflector	Dow Chemical	construction
Newberry Springs, California	hectorite processing	parabolic trough	National Lead Industries	design only
Hobbs, New Mexico	oil refinery	parabolic trough	Southern Union Co.	construction
San Antonio, Texas	brewery	parabolic trough	Lone Star Brewing Co.	design only
Henderson, Nevada	chlorine manufacturing	parabolic trough	Stauffer Chemical Co.	design only
Ontario, Oregon	potato processing	parabolic trough	Ore-Ida Co.	construction
<u>Privately Funded</u>				
Youngstown, Ohio	aluminum anodizing	fixed half parabolic	General Extrusions, Inc.	operational (Sept. 1977)
Jacksonville, Florida	beer pasteurization	evacuated tube	Anheuser-Busch, Inc.	operational (Feb. 1978)

Although strict economic analysis may not dictate adoption for some time, solar energy may nevertheless be attractive in certain areas of the country and for certain industries.

Procedures for Offsetting

Should a company decide to go ahead with a solar offset program, what is the proper course of action? The answer depends to a large extent on the nature of the company's proposed operations. If relatively minor design or operational modifications are proposed, internal offsets will be most practical, particularly if the bubble concept has been adopted in the SIP. If major expansion or new construction is desired, a larger, external offset may be necessary. Growth allowance offsets, particularly if created through a governmental-sponsored cost-sharing arrangement, may be feasible.

Offsets may be initiated either by the owner of the proposed source or by the appropriate state or local government. In a state of community-initiated offset, the state or local government commits itself to reduce emissions from existing sources enough to outweigh the impact of the new or modified source. In either case, the offset must be submitted as a formal SIP revision.

Ultimately, government-initiated offsets may be the vehicle through which solar energy is blended with the offset program. Because of the high initial investment required for solar energy, a cost-sharing arrangement involving both industry and government would be desirable. Both entities would benefit from such an arrangement--industry by being allowed to locate where it chooses, government by the additional revenues and jobs accruing from industrial growth. Unlike dollars invested in pollution control equipment, solar-invested dollars would produce a tangible economic benefit--energy.

CONCLUSION

The concept of cleaning up the air through solar technology has intrinsic appeal. Without betraying the cause of clean air, demands for industrial growth and energy self-sufficiency can be answered. Without

undermining the operation of the marketplace, incentives for solar energy investment are created. The concept represents, in a very real sense, the best of both worlds.

But intrinsic appeal does not always mean economic good sense. Until additional financial incentives for industrial investment in solar energy are created, solar offsetting will remain a conceptually sound, yet economically unrealistic, idea. Once these incentives are created and it is demonstrated that solar energy can work in an industrial setting, solar offsets can and should be encouraged. Until then, decision makers in both industry and government should study the potential of the proposal with an eye to the future.

INCENTIVES FOR SOLAR ENERGY: A CONGRESSIONAL PERSPECTIVE

James W. Spensley and Sarah Glazer

Over the years, federal legislation has contained numerous incentives designed to motivate people and institutions in the energy arena. In most cases, those legislative actions were conscious decisions to affect behavior in the market place. Some clearly were not. That is to say, Congress has in the past inadvertently created incentives and disincentives that have resulted in unexpected and undesirable outcomes. Today we would like to offer a few explanations for some of those past transgressions, along with some new ideas.

The Committee on Science and Technology is concerned principally with civilian research, development, and demonstration in all areas of the Federal Government. The Committee's experience evolved from its early responsibility for the space program in this country. More recently that responsibility has expanded to encompass general science and technology issues, transportation, environment, communications, aviation, and energy. In the energy area, the Committee has been responsible for numerous laws containing a spectrum of financial incentives for solar technologies.*

In formulating such legislation, Congress universally observes several important constraints. Appreciating those constraints gives one a better understanding of why the incentives are written into legislation as they are.

The first and most important is a parochial consideration: the jurisdiction of the committee proposing the legislation. A piece of legislation drafted to fit neatly inside the boundaries of a committee's

*The Federal Non-nuclear Energy Research and Development Act of 1974, the Solar Heating and Cooling Demonstration Act of 1974, the Geothermal Energy Research Development and Demonstration Act of 1974, the Solar Energy Research Development and Demonstration Act of 1974, the Electric and Hybrid Vehicle Research Development and Demonstration Act of 1974, the Solar Photovoltaic Energy Research Development and Demonstration Act of 1978, the Wind Energy Systems Act of 1980, and the Ocean Thermal Energy Conversion RD&D Act of 1980.

jurisdiction is a highly prized commodity in Congress. Its narrowness protects the authoring committee from the power grabs of hostile or rival committees.

Tax incentives are the exclusive territory of the House Ways and Means and Senate Finance Committees; loans and loan guarantees are largely the responsibility of the Banking and Currency Committee; energy pricing regulations and commercialization programs are in the purview of the Interstate and Foreign Commerce Committee; research and development falls within the Science and Technology Committee.

This array of diffused responsibility often forces committees to limit themselves to those incentives that may not be the most appropriate. It also forces committees to strain the descriptions of their proposals to fall within their jurisdiction. A good example is the frequent attempt by the Science Committee to "commercialize" a technology by commercial-type incentives that it dubs "demonstrations." Demonstrations fall within Science's jurisdiction; commercialization does not.

The second consideration in drafting federal incentives is concern for a balanced federal budget. This year, the issue took on particular importance as both the Carter Administration and Congress stated their determination to balance the budget. So-called "off-budget" incentives suddenly became very popular. These included the whole array of energy incentives that Carter proposed to fund with the revenues of the windfall profits tax. Soon there were numerous proposals for programs to be funded directly from the windfall tax revenues--among them the Solar Bank--instead of the conventional annual appropriations process. Even the fiscally conservative Appropriations Committee tried to find an off-budget way to finance the synthetic fuels reserve by proposing a \$20 billion appropriation to be "subject to further appropriation."

The final and most important consideration is whether the incentives we propose will have the effect we want and will be targeted at the appropriate person or institution. Clearly, the incentive must be appealing and have a positive effect on desired behavior.

In several instances, manufacturers have lobbied furiously against governmental largesse intended to benefit them for fear that the advertisement of impending governmental "freebies" would stymie--rather than encourage--the market. This concern was borne out in 1978, when potential solar consumers, awaiting final passage of the federal solar tax credit, delayed their purchases and imposed a devastating toll on the solar energy industry.

Recently a wind machine manufacturer raised another reason for opposing federally subsidized purchases. He argued that potential customers would interpret federal incentives as a sign that the technology was not fully developed and not ready to be purchased as a commercial item.

Another pitfall is demonstrated by the incentive embodied in the Energy Security Act of 1980. Despite the general consensus that a successful synthetic fuels industry will require the participation of the major oil companies, the incentives adopted are not attractive to those oil companies. The incentives--loans, loan guarantees, purchase price support agreements, and joint ventures--would be more appropriate for companies short on capital--something the oil companies have plenty of. Large oil companies would have preferred tax incentives, such as accelerated depreciation. Why didn't the act include tax incentives? The answer is to be found in the first constraint mentioned earlier: committee jurisdiction. Inclusion of tax incentives would have forced the authorizing committee--House Banking--to open its doors to the tax-writing committees of Congress.

A related question that has faced the Science Committee in designing incentives concerns the proper recipient: manufacturer or consumer. The argument for subsidizing the manufacturer is that the subsidy temporarily reduces the price of the product, giving the manufacturer additional time to improve the product and to reduce his cost to competitive levels. The disadvantage is that the manufacturer may simply capitalize on the federal windfall if he is not motivated to produce a competitive product.

On the other hand, a subsidy to the purchaser gives the manufacturer a greater incentive to reduce costs, by requiring him to put his own resources into its manufacture. Yet this subsidy can be abused too,

especially in the case of an already competitive product. A good example is the California experience with the state's solar energy tax credit. The average price of a solar-heated swimming pool increased by exactly the amount of the tax credit. Both approaches pose a dilemma.

Overall, the Congress has not had sufficient experience in using its authority to effectively manipulate the marketplace. Thus, it is easy to conclude that the Federal Government has never been successful in commercializing anything because of its limited capacity for innovation and responsiveness.

Although we have set forth a somewhat skeptical view of our ability, hope still abounds. Thus, we still want to relate to you some of our new efforts to seek innovative approaches to affect marketplace behavior. These examples relate to our subcommittee's responsibility in promoting energy conservation. Those efforts most recently have been directed at providing incentives for industrial energy conservation and motivating utilities to get involved in residential and commercial conservation. Both efforts began in workshops organized by our subcommittee with members of the industrial and financial community. The industrial conservation effort has been extended through a task force, which has been discussing new schemes for meeting some of the considerations described earlier.

In the industrial conservation area we are looking at the use of joint ventures between government and industry to promote investments in energy-efficient equipment. The concept originally arose as a way to attract private capital to conservation investments in industries that have already exceeded their borrowing capacity. In many cases, American industries tell us they could go to the bank to raise money for cost-effective investments in conservation but they do not want to jeopardize their debt/equity ratio. An increase in debt, they note, will hurt their bond rating, making them even less attractive to investors and stockholders.

One proposed scheme envisages the Federal Government--in the form of a new public corporation--acting as the intermediary between private investors and private industry that is unable to borrow from those investors. Under the proposal, the public corporation would invest in new

energy-saving equipment in an industrial plant as a partner with the manufacturer. The industry would repay the government through its energy savings--plus interest and a fee--until it had bought out the government's interest in the joint venture.

How would the government pay for the capital? Congress would initially appropriate a sum of money for operating capital. But later we expect that the federal corporation would raise money in the private investment market. Investors will be attracted because the corporation will guarantee the investment against default. The industry will benefit because it will avoid having to make a large front-end investment. Further, the industry will not have to bear the full burden of debt for its investment, since the public corporation will carry its share of the investment on a separate balance sheet. Finally, the government will benefit financially because it will recoup its initial investment and perhaps some profits through industry's payments. Other national benefits would be the saving of large amounts of energy as well as modernizing industry.

We are hopeful that this scheme will meet two of the constraints mentioned earlier: concern about a balanced federal budget and the necessity for targeted, effective incentives.

There are at least two existing quasi-governmental corporations that engage in joint ventures with industry for the purpose of developing and marketing new products. In the process, they expect to make a profit for the government. In England, the government's National Research Development Corporation, in existence since 1949, has been turning a net profit since 1969 to the tune of 10 million pounds. The NRDC invests in high risk, promising new products of private companies. If the product is successful, NRDC receives a percentage of sales over and above its initial investment. If the product fails, NRDC simply accepts the loss.

Since 1975 the State of Connecticut has been operating the Connecticut Product Development Corporation, modeled after the British NRDC. The corporation was initially capitalized with a state bond issue and expects to start paying the state back in 5-7 years. Already the corporation has helped develop several successful products including a

currency counter, an irrigation controller, and a new automatic control for underground sprinkling systems.

Institutions such as these could be adapted to encourage the marketing of solar and other alternative energy products. The State of California, in fact, is studying these approaches with just that purpose in mind.

At a time when taxpayers are concerned about increasing governmental spending to aid private industry, the profit-making joint venture seems particularly appropriate. If the government is to help profit-making entities get off the ground, it seems only fair that it should share in the profits.

There is one last important constraint on congressional decision making worth noting. That is our inadequate knowledge of expected market behavior. To put it bluntly, we are shooting in the dark each time we propose any incentive in hopes of accomplishing some intended result. We have very little idea as to how much incentive is required to do the job--how many people will take advantage of the incentive and how much their behavior will be changed. Our experience and data are both limited with respect to what the payback requirements are for different groups in society. Simply stated, we need enormous market research in order to contribute to our understanding of the ultimate "consumer" of our incentives--the individuals and businesses whose decisions we are attempting to influence.

SOLAR PHOTOVOLTAIC ENERGY RESEARCH DEVELOPMENT AND DEMONSTRATION ACT OF 1978 (P.L. 95-590)

Forms of Incentives

1. Cooperative agreements (cost sharing on demonstration projects) up to 75% federal for purchase and installation
2. Grants for R&D activity (no specification on size)
3. General contract authority for procurement of systems by the Department of Energy (no specification)
4. Ten percent (10%) set aside for small businesses

SOLAR ENERGY RESEARCH DEVELOPMENT AND DEMONSTRATION ACT OF 1974
(P.L. 93-473)

Forms of Incentives

1. Cooperative agreements for demonstration (no specifications)
2. General contract authority (no specification)

SOLAR HEATING AND COOLING DEMONSTRATION ACT OF 1974 (P.L. 93-409)

Forms of Incentives

1. Grants for development of systems (no specifications)
2. Contract authority for R&D and procurement (no specification)
3. Cooperative agreements (no specifications)

GEOTHERMAL ENERGY RESEARCH DEVELOPMENT AND DEMONSTRATION ACT OF 1974
(P.L. 93-410)

Forms of Incentives

1. Cooperative agreements for demonstrations. Specific authorization for any demonstration with a federal share of over \$10 million (covers--exploration, siting, drilling, pilot plant construction and operation)
2. Loan guarantees for up to 75% of the aggregate cost of the project. Project may cover: resource assessment; R&D for extraction and utilization; acquiring rights to geothermal resource, and development, construction, and operation of commercial demo.
Limits: \$25 million maximum for any one project; \$50 million maximum for any one borrower
Loans are covered by a Geothermal Resources Development Fund established in the U.S. Treasury.

FEDERAL NON-NUCLEAR ENERGY RESEARCH AND DEVELOPMENT ACT OF 1974
(P.L. 93-577)

Forms of Incentives

1. Cooperative agreements--R&D and Demonstrations
2. Establishment of joint federal-industry corporation
(proposed for congressional authorization)
3. Price supports (specific authorization required)--planning grants
4. Federal purchases
5. Federal loans to nonfederal entities for new technology
demonstrations (or loan guarantees) under number (1) for demos:
 - a. If over \$50 million federal share the project needs specific authorization
 - b. Between \$25 and \$50 million: full and comprehensive plan to Congress but no authorization receiving
6. Financial awards to individual inventors

ELECTRIC AND HYBRID VEHICLE RESEARCH DEVELOPMENT AND DEMONSTRATION ACT OF 1976 (P.L. 94-413)

Forms of Incentives

1. General contract authority for R&D
2. Federal purchase and lease of vehicles for demonstration
(covers the differential operating costs for the EV's).
3. Loan guarantees for manufacturers:
 - a. up to 90% of the aggregate costs
 - b. up to \$3,000,000 per loan
 - c. \$60,000,000 fund total

OCEAN THERMAL ENERGY CONVERSION RESEARCH DEVELOPMENT AND DEMONSTRATION ACT (P.L. 96-310)

Forms of Incentives

1. General contract authority for R&D
2. Cooperative agreements for pilot plants (cost sharing no specifics)

THE WIND ENERGY SYSTEMS ACT OF 1980 (H.R. 5892)

Forms of Incentives

1. General contract authority
2. Cooperative agreements
3. Cost shared grants--larger machines
 - a. years 1-6 (50% maximum)
 - b. years 7-8 (25% maximum)
4. Federal procurements (small and large machines)
5. Loans, direct, for 75% of the total purchase and installation cost for a windfarm project
 - a. at least four projects (large or small)
 - b. combined total of 320 MeW

ENERGY SECURITY ACT (P.L. 96-294)

Forms of Incentives

1. Purchase agreements, price guarantees, and loan guarantees up to 75% of the project costs; loans up to 40% of initially estimated project costs unless such limits would prevent the financial viability of the proposed project in which case up to 75% would be authorized; and, a minority equity interest, under partnership law, in a joint venture (where the government could provide up to 75% of project costs) for commercial modules prior to approval of the comprehensive strategy.
2. Loans and loan guarantees: to extend financial assistance subject to appropriations, to cover (a) 50% of cost overruns up to 100% of the initially estimated project cost and (b) 40% of additional cost overruns, subject to congressional notification that the project cost exceeds 250% of the estimate on which the initial award of financial assistance was based, and (c) award financial assistance to qualified concerns to refine the design of proposed synthetic fuel projects to improve the accuracy of the initial estimated costs on which loans and loan guarantees are awarded.

PIFUA, PURPA, AND INDUSTRIAL USE OF SOLAR TECHNOLOGIES

Michael Shulman

The enactment of the Public Utility Regulatory Policies Act (PURPA)¹ and the Powerplant and Industrial Fuel Use Act (PIFUA)² in 1978 has led the solar community to believe that government regulatory action can effectively eliminate existing disincentives to solar energy and force industry to actively consider solar technologies. Detailed analysis of these two statutes indicates otherwise; these statutes have a very limited impact on potential industrial use of most solar technologies. These limitations are due to the language of the laws and the regulations promulgated by the Federal Energy Regulatory Commission (FERC) under the authority of these laws.

PIFUA

The Powerplant and Industrial Fuel Use Act (PIFUA, PL95-620, 1978) requires the Department of Energy to adopt regulations requiring major fuel burning installations (MFBI) to reduce or eliminate their use of natural gas and petroleum. Major fuel burning installations include all industrial boilers greater than 100 MMBtu/hr and an industrial site using several boilers between 50 and 100 MMBtu/hr that have a total output of greater than 250 MMBtu/hr. The size of this market is shown in Table 1.³

The data in Table 1 exclude electricity consumption, metallurgical coal, and miscellaneous petroleum products not used as feedstocks. These products account for an additional nine quads in 1990. If these nine quads are added to the 20.7 shown in the table, PIFUA affects only 8.7 percent of all industrial fuel use in 1990.⁴

PIFUA was designed to accelerate coal utilization in industry; FERC and the Economic Regulatory Administration (ERA) are promulgating rules that consider coal to be the major alternative to oil and gas consumption in industry. This limits the usefulness of PIFUA regulations to solar technologies. In fact, the actual provisions of PIFUA make it doubtful that any solar technology will benefit and achieve early market acceptance. This is because the MFBI regulated by PIFUA are eligible for

TABLE 1. Industrial Fuel Use Regulated by PIFUA--1990

<u>Regulated by PIFUA</u>	<u>Energy Demand</u>	
	<u>Quads</u>	<u>Percentage</u>
<u>Boilers</u>		
New (installed 1982-1990)		
Large	2.6	13.0
Small	0.7	3.0
Existing		
Coal Fired	1.5	7.0
Coal Capable	0.1	0.5
Oil/Gas Fired (non-coal-capable)		
Large	1.7	8.0
Small	1.2	6.0
<u>Process Heaters</u>		
New (installed 1982-1990)	3.6	17.0
Existing	4.2	20.0
<u>Feedstocks</u>	5.1	25.0
TOTAL	20.7	99.5

a host of temporary and permanent exemptions from FERC regulations banning natural gas and petroleum use.⁵

Installations are eligible for exemptions if they can demonstrate:

- o lack of a reliable, adequate, and reasonably priced supply of an alternate fuel
- o site limitations
- o pollution problems
- o the use of synthetic fuels as part of their power source
- o the burning of petroleum or natural gas is in the public interest
- o that the use of an alternate fuel will affect the ability of the site operator to cogenerate
- o there is a lack of adequate capital
- o that only petroleum or natural gas combustion will allow the site operator to meet process requirements or assure adequate quality control.

These exemptions can vary from 5 to 15 years at the discretion of FERC. To date, only one company, J. P. Stevens, has been ordered to convert to coal. This order was issued with the concurrence of the company, because the conversion order allows Stevens to break a 15-year natural gas contract on the grounds of force majeure.⁶

Two provisions of the law concretely aid biomass technologies. They provide that:

- o installations that will use synthetic fuels in the future may receive an exemption for ten years; and
- o installations that will use an alternative energy source (including coal) for 75% of its fuel heat input rate may receive an exemption for five years.

This latter provision has limited usefulness in that few solar systems with the exception of a few biomass, solar thermal repowering, and solar thermal enhanced oil recovery installations, could produce 75 MMBtu/hr of output; a biomass system rated at 75 MMBtu/hr would require roughly 20,000 acres of forest to supply chipped wood over the 20-year life of the plant.

Perhaps the most damning provision is the permanent exemption for cogeneration facilities that can demonstrate that using fuels other than natural gas or petroleum will affect the reliability and performance of their system. Cogeneration technology is available and will probably achieve a certain success in the marketplace. This is a part of the PIFUA-regulated market that will have a regulatory right-of-way to burn petroleum and natural gas and avoid consideration of solar technologies. The bias in the regulations is potentially strong enough to retard the use of biomass cogeneration systems in the paper industry; biomass-fueled systems are more expensive, dirtier, and less reliable than natural gas or petroleum-fired cogeneration systems.

The other criteria for exemptions are all designed to provide a transition period for industry to switch to coal; this explains exemptions based on environmental problems or future use of synthetic fuels. PIFUA, therefore, is not a law removing previous disincentives to alternate energy use and raising the real price of oil and gas; it is a law designed to promote coal utilization and skew industrial energy use away from

natural market forces. For this reason, PIFUA's impact should be quantified and included in the analysis of incentives for energy production.

PURPA

The Public Utility Regulatory Policies Act, PL 95-617, of 1978 was designed to promote energy conservation through innovative use of resources and rates by electric utilities. The key provisions affecting industry are:

- o the designation of Small Power Production Facilities (SPPFs) as exempt from conventional state and federal utility regulation
- o the use of FERC to promote the development of cogeneration facilities (CFs) and fair utility buy back rates
- o the development of elective rates reflecting the marginal cost of electricity production.⁷

SPPF

Small power production facilities are defined by PURPA as those companies:

- o using renewable energy sources for power production (except for small amounts of fossil fuel for startup and flame stabilization)
- o which have generation capacity of greater than 10 kWe and less than 80 MWe
- o are decentralized producers of power
- o are owned by a person not primarily engaged in the generation or sale of electric power (other than electric power solely from cogeneration facilities of SPPFs)

SPPFs are entitled to interconnect with utilities, and are exempt from state utility regulation. SPPF are expected to seek official certification from FERC (and exemption from state regulation) only if they are denied fair rates and interconnections with existing utilities.

Cogeneration Facilities (CF)

PURPA does not mandate that cogeneration facilities (CF) use solar energy as their primary source of power. The provision is intended to conserve fossil fuel through more efficient use of the waste steam

available from industrial on-site electric power generation facilities. The most important statute for cogeneration in PURPA mandates FERC to promulgate regulations that require electric utilities to buy and sell power to CF (and SPPF) at rates that are nondiscriminatory.⁸ FERC's preliminary rules state that utility rates to cogeneration shall not exceed the cost to the utility of electric energy that the utility would have to cogenerate if not for the capacity of the cogeneration facility.

Cogeneration facilities, like SPPFs, are exempt from the Federal Power Act, the Public Utility Act, and state regulation. Cogeneration facilities can be of any size or capacity, due to a lack of accurate technical definition of size limitations for cogeneration systems.

Model Rates

FERC, to date, has not issued model rates for cogenerators or SPPF. It is known, however, that the model rates and rules for utility ratemaking will embrace the need for marginal cost pricing using time of day, seasonal, and inverted "block rates" for industrial as well as residential and commercial users.

The statutory provisions mandating SPPF are the most important regulatory incentive for solar technologies. There are several options available to a company to make use of the SPPF provision; a few of these options are:

- o The direct installation of solar technology facilities to produce electric power or cogenerate.
- o The creation of a leverage lease subsidiary that qualifies as an SPPF. Leverage lease subsidiaries' debts are usually considered an off balance sheet debt obligation, and can be used to reduce borrowing costs. These subsidiaries would use solar technologies to generate electric power or cogenerate.
- o Enter into a partnership arrangement with an entrepreneurial firm setting up an SPPF, with a direct buy agreement included in the partnership.

- o Being the credit guarantor of an entrepreneur setting up an SPPF by guaranteeing the purchase of power from the SPPF at a fixed rate or buying bonds to finance the construction of the power facility.

Wind systems are the most likely solar technology to be used in near-term (1980-1985) SPPF; in the long term, solar thermal technologies have an advantage of being capable of cogeneration and would, therefore, be exempt from the SPPF size limitations stipulated in PURPA. Biomass cogeneration systems are currently being used by the paper industry and their use may accelerate due to the CF provisions in PURPA.

PURPA, in theory, eliminates many regulatory barriers to solar technology utilization and should help small businesses and innovators in dealing with large utilities. However, several provisions in the law, including the certification process to obtain status as an SPPF or CF, raise new regulatory barriers and will increase the cost of doing business for SPPF and CF. Many large companies financially incapable of dealing with this problem may not want to undergo scrutiny from FERC, although certification processes are supposed to be relatively simple.

The most significant impact of the PURPA statutes, when added to those contained in PURPA, are the enormous regulatory advantages granted to oil- and gas-fired, and to some extent, coal-fired cogeneration systems over solar technologies. Cogeneration facilities have no size limitations and the certification procedures will probably be less stringent than for SPPFs, due to the maturity of the technology. Cogeneration facilities qualify for permanent exemptions from PIFUA regulation. If PURPA and PIFUA successfully promote oil- and gas-fired cogeneration, the nation could possibly experience:

- o a slower market acceptance of solar electric technology, especially wind, than expected;
- o the situation of oil- and gas-fired cogeneration systems displacing coal and nuclear powered baseload electric power capacity.

A vigorous analysis of the true impact of PURPA and PIFUA on the industrial energy markets they regulate is necessary before firm

conclusions can be drawn; however, it is clear that these two laws will not benefit solar technologies in any significant way for at least ten years, and possibly through the turn of the century. Their impact, when quantified, should be included in the Battelle incentives analysis.

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THE EXPERIENCE IN THE NORTHEAST WITH THE HUD INITIATIVE

Eric M. Olson

Introduction

The current pattern of energy usage in the United States has been shaped by a vast variety of subsidies and incentives. These incentives and their costs have been well documented by Bruce Cone and his associates. The nation is now in the process of developing alternatives to the existing energy system which is supplied almost entirely by oil, natural gas, coal, nuclear and hydro-electric. The alternatives include geothermal, cogeneration, and the various solar or renewable technologies: wind, biomass, solar thermal, passive, active heating, and alcohol fuels. It has been recognized ever since the start of the energy crisis with the Arab oil embargo in 1973 that the alternatives will also require incentives if they are to compete with the established energy sources. The rationale for such incentives is not only that the renewables should compete on an equal footing, but also that additional incentives are justified because the solar technologies are environmentally benign, purely domestic, immune from foreign interference, and finally because the price of fossil and nuclear fuels does not reflect their true costs, which may be several times larger.

Today an impressive array of solar incentives is in place with more authorized but not yet implemented. These incentives include tax credits, grants, tax exemptions, low interest loans, as well as a large government-sponsored research and development program. The incentives are provided both by the federal and state governments. For example, in Massachusetts the combined federal and state tax credits reduce the cost of a \$3,500 domestic solar hot water system to \$1,365. The solar incentives have been in place a relatively short time, and it is not clear how effective they are. The solar technologies are sufficiently different from the nonrenewables that the experience with oil, nuclear, etc., is not transferable. However, there has been one solar incentive program, the HUD Hot Water Initiative which, despite being limited in time, size, and

geographical scope, can give us some insight into the issue of incentives.

The HUD Hot Water Initiative was a program of \$400 grants that was carried out in the states of Florida, Maryland, Delaware, Pennsylvania, New Jersey, 13 counties of New York, and all of New England except Maine. This paper briefly discusses the experience with the HUD Initiative. The discussion is from the point of view of the Northeast Solar Energy Center (NESEC) and arises from our experience with the program and not from an in-depth analysis of the results. At the start of the Initiative NESEC was merely a very interested observer; at the conclusion, the Center was very deeply involved.

Program Description

The HUD Hot Water Initiative was a part of the Solar Demonstration Program administered by Housing and Urban Development on behalf of the Department of Energy. Early in 1977 DOE and HUD judged that the solar hot water technology was reasonably well developed and that, while many companies were in the business, the market was not taking off. The grant program was established to provide some "market pull" and thus to help the industry establish momentum.

Approximately 11,000 grants were to be distributed. The particular states chosen for the program were selected on the basis of their electric rates, generally the highest in the country. The program was viewed primarily as a marketing effort, no R&D was involved, so the administration was left to the states with HUD setting overall direction and maintaining oversight. HUD stipulated that the systems receiving the grants were to provide at least 50% of the hot water requirements for a family of four. In addition, eligible systems would have to comply with the HUD Minimum Property Standards for Solar Domestic Hot Water Systems and both the manufacturer and installer would have to provide extensive warranties: five years for the collectors, tank, and heat exchanger, and one year for the other component parts and installation. The Northeastern states retained PINY (The Polytechnic Institute of New York) to determine the eligibility of systems on the basis of data provided by the manufacturer and independent testing laboratories. (In Florida this

function was carried out by the Florida Solar Energy Center.) PINY also provided technical support and installation guidelines.

The program was announced at the end of March 1977 and was to be completed by 31 August 1978. Funds were provided to the state energy offices for the administration of the program and to publicize it. Announcements were made through the press, radio, TV, and bill stuffers. The applications came streaming in to the state energy offices by September 1977.

Program Events

The program encountered a series of severe problems, and for awhile it looked like the Initiative plus other federal incentives would lead to the demise of the infant solar hot water industry in the Northeast. (Experience in Florida was somewhat different.) Some of the problems will be discussed below.

In the spring of 1977 the New England Electric System (NEES) solar hot water experiment had completed its first year and had shown very poor results due to many inadequate system designs and almost universally poor installation practices. Because of the resulting bad publicity, the warranty requirements cited above were required. These requirements caused the solar industry great pain because of the limited product experience and the implications of the Moss-Magnusson Act. Despite many complaints, the warranty requirement was maintained. In the end the industry was probably helped by being forced to deal more effectively with its reliability problems. The warranties also went a long way to countering the poor publicity that solar hot water heaters had received. The cost to the consumer was an increase in price of somewhat over a hundred dollars.

Other problems at the start of the program were disagreements over the details of the minimum property standards and the methodology by which the 50% solar fraction was determined. A major shock to the DOE and HUD officials who had initiated the program was the discovery that a high percentage of the applicants were do-it-yourselfers who intended to buy components and install their own system. This was viewed as both negating

the purpose of the program, to help the industry build its infrastructure, and to be an invitation to disaster with improperly installed equipment, consequent failures, and bad publicity. This issue was resolved with a series of installation seminars open to all installers and applicants. Attendance at the seminars was mandatory for do-it-yourselfers in some states. The insistence on the need for the seminars and the actual conduct of that aspect of the program in cooperation with NSHCIC (National Solar Heating and Cooling Information Center) was the first active role of the Center in the Initiative.

However, the major problem that caused truly serious difficulty was delay. While the applications were due into the various state agencies by September 1977, the first systems from eight manufacturers out of the 175 that had shown initial interest were not approved until January 1978. It was not until late in the spring of 1978 that most of the systems of the approximately 70 manufacturers that had maintained an interest were approved. The principal cause of the delay was the inadequate number of laboratories that could carry out the required tests and the poor weather in the fall of 1977, which made completion of the mandatory 30-day stagnation test virtually impossible.

The other element of delay was the long wrangle over the National Energy Act of 1978. The solar incentives of this Act were to be retroactive, but it was not clear that the incentives would be in the final legislation. Thus some potential buyers lost interest in the time period between the initial announcement and issuance of the approved list of systems, while others who looked to both the grant and the NEA tax credit were holding off to see if the tax credit would be implemented. In the meantime, sales dwindled. The expiration date of the program was extended several times. As 1978 wore on, the solar hot water industry in the Northeast (and, in fact, nationally) was in severe difficulty. Manufacturers were dropping out of the business. Some of these were marginal firms, but others had good products and solid sponsorship. Many of the best and most experienced installers were ready to drop out.

In January 1979 a senior official of one of the major solar manufacturers came to the Northeast Solar Energy Center and very clearly

delineated that a situation we knew was bad, was indeed critical. As a result of this visit and the reports of solar installers, the Northeast Solar Energy Center launched a major effort to commercialize solar hot water systems. This effort, "Operation Sunpower," was a cooperative effort of industry, the states, and the Northeast Solar Energy Center. It had the full support of DOE and HUD.

In January 1979 only 1,362 out of 8,117 grants allocated in the Northeast had been installed. The grant program was now scheduled to terminate on 31 December 1979. Operation Sunpower consisted of three components: first, to assist the industry with marketing and installation workshops and marketing materials; second, to provide field workers to assist the state energy offices with their efforts; and third, and most importantly, to conduct an intensive publicity campaign that emphasized the seriousness of the energy crisis, the availability of solar hot water equipment, that the systems were reliable and cost effective, and the availability of the grants and tax credits. This campaign we believe reached most adults in the states participating within our region by the exploitation of bank and utility bill stuffers, trade/home shows, press conferences, newspaper interviews, magazine articles, radio/TV appearances, and public service announcements. We also reached more limited audiences with targeted mailings, workshops, and speaking engagements. By the end of 1979 most of the remaining grants had been installed or were firmly committed. Certainly the dramatic increase in the price of oil had a major influence, but we estimate at least 50% of the installations were due to the efforts of Operation Sunpower. At the end of the program the solar industry was in good shape and most installers had substantial backlogs.

Conclusions

The HUD Initiative was a very small program when compared to the incentives now in place. Nevertheless, there are some lessons to be learned. Delay and confusion with an incentives program can be disastrous for a new and fragile industry. For a time, many people in the solar industry expressed the wish that there were no grants or tax credits--they were deemed a greater hindrance than help. Once an incentives program is

announced, it must have high probability of enactment and be implemented rapidly.

An incentives program that is directed at the general public must be backed up by an intensive and properly timed information campaign, especially when the resources of the industry being aided are limited. Incentives that aid profit-conscious industry need little promotion; however, the general consumer needs a great deal of education.

Before any incentives program is announced, great care must be taken to understand the status of the industry, its capacity to expand, the capability of its service and installation network, and the probable consequences of mandated performance requirements. In other words, it takes careful planning based on a knowledge of the real world marketplace.

INNOVATIVE FINANCING FOR INDUSTRIAL APPLICATIONS OF SOLAR TECHNOLOGY*

William C. Dickinson and Charles B. Wilde

The capital-intensive nature of large-area, industrial-solar process heat systems presents a major deterrent to their mass produced commercialization and acceptance by industry. For example, present quoted installed costs of large-area ($> 100,000 \text{ ft}^2$), parabolic-trough systems, taken together with presently available investment tax credits and accelerated depreciation schedules, indicate that on a life-cycle cost basis, allowing a 15% after-tax market rate of return on solar investment, these systems are very near to being competitive with the cost of distillate oil. However, no private-enterprise, nonfederally subsidized market appears to be developing for these solar systems, even though many industries in every region of the country use large quantities of 350°F- to-500°F process steam, which parabolic troughs are able to provide at reasonable efficiency.

The primary reason for this lack of early market penetration is the high initial capital investment required from the industrial user. A $100,000 \text{ ft}^2$ (aperture area) parabolic trough system can be installed today for approximately \$3,000,000. In Southwestern locations this system should provide about 25,000 MBtu of process heat annually, replacing about 5,000 barrels of oil. However, the cost of investment capital is high, and its availability is limited. Most companies have higher priorities for investment opportunities than provided by a relatively untried and high-risk solar technology.

This paper will describe work underway at the Lawrence Livermore National Laboratory, in conjunction with members of the Winthrop Financial Co., Inc., and other consultants from the financial and tax law community, to determine methods of financing large-area-solar-process heat installations which, with proper incentives, would be attractive to potential industrial end-users.

Two approaches will be briefly described below.

*This work is supported by the Office of Solar Applications to Industry, Department of Energy.

The Solar Management Company (SMC)

This approach utilizes a limited partnership structure in which the SMC would serve as the general partner in forming a partnership to construct, operate, manage, and own a solar installation at an industrial site. The SMC would form a separate partnership to own each solar installation.

The limited partners in each partnership provide the necessary equity capital and participate in all income and losses. Debt financing is provided by conventional lending sources (e.g., banks, insurance companies, pension funds). The ratio of debt to equity capital for a particular partnership would be between 3-1/2 to 1 and 4 to 1. The partnership would own the equipment and sell energy to the end-user on a "take-or-pay" basis. (End-user agrees to take and pay for all energy produced by the solar system over the length of the contract.) The "take-or-pay" contract would call for price escalations in solar-generated steam delivered from year to year, but at a discount to generally escalating fossil energy costs.

The tax incentives (investment tax credits, depreciation, and interest deductibility), expenses, and cash flow would pass through to the individual limited partners. Individuals in the highest tax brackets will be able to best utilize these tax incentives and therefore will find a high risk investment of this nature most attractive.

The partnership would be responsible for operating and maintaining the solar installation, taking all responsibility off the end-user. The solar management company would either form an equipment management company for this purpose or possibly contract for the services of an independent company. The equipment management company would most likely operate and maintain a number of solar installations, some or all under the management of one solar management company as the general partner representative of the individual partnerships.

This management structure, consisting of a general partner and a number of limited partners contributing equity capital, together with heavy loan leveraging, is well known in the real estate, oil and gas, and

equipment-financing industries. Many commercial buildings, shopping centers, and other multi-million-dollar construction projects are financed in this way. Over one billion dollars per year is raised to fund oil and gas exploration and development programs. Figure 1 diagrams the form of this approach.

There are two key considerations that must be changed through legislation for this method of financing to be viable for large-area industrial solar systems:

- (a) The "at-risk" provision enacted by Congress in the 1976 Tax Reform Act would have to be waived as it presently would pertain to solar collecting equipment (currently only real estate investments are exempted from this provision).
- (b) Some existing or new governmental agency must be empowered to make governmental guarantees available to the debt since it is unlikely that conventional lending sources would consider a "take-or-pay" contract as iron-clad security to a long-term lending commitment.

Conventional Lease Financing

At the presently prevailing installed costs of large area industrial solar systems this form of financing is not yet attractive, either to a leasing company (lessor) or to a potential end user (lessee). However, if the use of the solar management company technique were to be successful in substantially increasing the production level of the solar collector manufacturers, they should be able to justify substantial capital investment leading to mass production capability of parabolic troughs (and other collector types as they reach the commercialization stage). In this way system costs should come down substantially, perhaps to the level of \$20 per ft². Were this to happen, solar-provided heat would become competitive with oil and gas, at first in the sunbelt regions. The lease financing approach would then become an attractive and simple way to finance these systems, removing the burden of large capital investment from the end-user and placing it with the leasing company.

FIGURE 1. Solar Management Company Approach

INCENTIVES FOR THE FUTURE

Raymond Anderson

I'm Ray Anderson. I work for the Washington State Energy Office. I'm also the Office's representative on the Energy Facility Siting Evaluation Council that sites oil pipelines, coal plants, and nuclear plants. I'm also Vice Chairman of the Board of Directors for Western Sun, but my remarks today are not going to express the views of any of these organizations.

Going through the Battelle report, it analyzes the incentives which have been given for energy development, or the historical incentives. I guess basically it sets the tone that if government has historically been in the incentives business it should continue to be in that business for solar. It analyzes the types and the amounts of these incentives. When it got into attempting to analyze the results of these incentives, that is when things started to fall apart. I think basically that a lot of these incentives were probably not really given to generate or to find a certain amount or to produce a certain quantity of energy. Probably the only one that increased the quantity produced at all was nuclear, and I think that we are going to fall far short of our goals for nuclear energy as far as the year 2000 goes.

In analyzing incentives, then, of how many dollars should be applied to solar and what the results are going to be, it is extremely difficult, because there is really nothing to base it on, and the only thing that there is to base it on is going to fall far short of what the goal was. Maybe a better way of looking at what future incentives ought to be is to look at what if we go solar and what if we don't. If we don't go solar, there are going to be future incentives for gas, oil, synthetic fuels, nuclear plants, and I think those are fairly quantifiable. We can look at if what can be done solar-wise and come up with maybe a better number of incentives that could be applied to to develop solar.

One of the real problems of solar is not that there are one or two industries really involved with it. It is trying to motivate every family or every person in the United States, and this gets to be very scary, and

how do you really fairly give an incentive to an individual, and how do you really know that you're going to get back the energy that you think you're going to get back by giving this incentive. We're coming along at a time where we have to analyze and have data on everything, and I think it has been pointed out that the consultants are doing quite well. But in looking to the future, I think we have to tie in both the past and the future, and my suggestion is really to work through the existing institutions such as the utilities. If they are faced with having to expend the capital dollars for new generating plants, why shouldn't they be also be the vehicle to expend the incentive dollars to bring solar into their area instead of building new generating plants or new peaking turbines.

I guess I want to end up somewhat by plugging the consultant market and Battelle, and then I think the incentive analysis ought to look not just on what's happened in the past and how many dollars that we could project into the future, but at what is really going to happen in the future if we do go solar and if we don't go solar, and then come up with the dollars that should be applied to solar. I am very supportive of phasing out the incentive program. I think one of the things that I have noted in traveling around the West is distributors' local marketing is not really picking up their share of the burden of providing advertising, really getting out and selling and marketing their products. I was very pleased to see the ad that Arizona had in the paper, that's the first one I've seen of that magnitude. Another thing that I think government ought to do is to remain in and maybe expand their efforts in the research and development. It still boggles my mind when I look at the cost of a solar system that was mentioned. A one square foot a collector will collect at about a maximum 200,000 Btu's a year. That is still more expensive capitalwise than a nuclear plant. And if you've ever toured a nuclear plant and look at its complexity, and looked at a solar collector, it does not make sense that you can build a nuclear plant cheaper than you can build a solar collector. So there is the problem of the technology. The solar collector uses way too much raw materials for its output. The cost of it is still way too high, and the people sense this. They are not flocking to solar as fast as we expect them. I think that government

should remain in the research and development field to develop new and better materials that are going to have less of an impact on our natural resources.

BEHAVIORAL APPROACH TO IMPLEMENTATION OF INCENTIVES

Rosalyn Barbieri

My comments are a little more extemporaneous, in part because I didn't know I was coming until almost last week. I'm coming from a little bit of a different viewpoint than I think many of you here, though the area in which I've had most of my work has really been in looking at market activities, information dissemination, and communication, and I think there have been a number of things today that have been really interesting to me in terms of how you begin to look at incentives. Obviously the first question is really what is the role of the government in looking at how you promote solar technology. And I think it's a very valid question. Skip brought up the point that Congress was saying let's not have as much research and development, let's get out there and commercialize. The question becomes is that an appropriate role of the government, and if you are going to do that, at what point, then, do you say the government has some appropriate roles, there are certain things that it can do. My particular feeling is there is a number of different ways the government can do it.

The other question you have to ask is what do you mean by an incentive. When I came here my concept in having just briefly read through some of the summaries of the Battelle report was an incentive was a tax incentive or it is dollars that are expended that somehow go directly back to an individual or to a corporation or something of that nature. But in fact you've got many different kinds of incentives, at least from my particular perspective. You obviously have the fiscal type or the legislative type of incentives which can be a dollar outlay. It can be setting up a particular program in order to do something; but then you also have the actual programmatic type of incentives that you can get to try and get someone to promote the use of solar. It's tied up into how you put together a program to develop a technology or put together an information dissemination program, and there may be nothing within that type of activity which you can use to promote solar. It also can be in terms of what to do when you let out a contract for solar research and development. That can determine how many industries, the type of

industry, and the amount of enthusiasm you're going to get from industry in terms of participating in a solar program. Do you put it out strictly as an RFP, or do you use other types of contracts. They each have particular characteristics that will generate certain types of information.

There is also the idea of cost-sharing. What do you mean by cost-sharing. How do you set it up so that in fact you're not getting ripped off and are getting the type of information back from industry that you want? How do you begin to evaluate the quality or get the quality of results back from a contract that are going to be cost effective? When you set up something such as the HUD demonstration program or the New England water heating initiative, something of that sort, how do you make sure that what you get for the money put in is in fact going to develop the kind of systems that ultimately are going to get commercialized? These are questions that really have not been examined. We talked a little bit before about the idea of innovative financing. Well there's innovative procurement. How does that come up as an incentive that maybe we can begin to use. The other thing is informational. You may not call it directly incentives, but information is a very vital element for someone to make an intelligent decision in order to purchase a solar energy system. Those informational types of incentives, as I might call them, are being used to a certain extent within the Department of Energy, but people don't know how to define them. They don't necessarily know how to implement them such that they will get congressional support for putting money into those activities.

What Skip mentioned as far as market research is another way of trying to generate information that you need in order to better tailor your programs and your incentives and your activities to support solar. But again, we don't really know how to do that. I know within the programs we have that even at the laboratory you put up information dissemination, market research applications for analysis. Those are words that sound good, but we don't know what they mean; we don't know how to set them up, and somehow these buzz words are going to get the dollars allocated to them. But can we actually go out and do the kind of work and the analysis and gather the kind of data that we need?

The other type of activity or incentive is what I call net workings, which means how can the government stimulate others to do the kind of things that need to be done to promote solar. That gets into how does the federal government stimulate or work with state and the local governments to stimulate solar. We have seen the federal government's going to the states, but we have also seen it run into problems by doing this. States are very jealous of their particular authority, and when the federal government says here's funding now I want you to win my program for me, there are some very good studies. There's a fellow particularly in Delaware with whom I have talked on a number of occasions, who tells me that the Delaware state legislature doesn't have any interest at obtaining government funds unless its under their conditions, because they don't want strings attached. But the state and local industry or state and local facilities for generating either state tax incentives or getting information out is a very important "incentive" that I think the federal program can use in terms of trying to get the word out on solar.

It's not just the research and development dollars, but its saying okay, if you've got research and development results, how do you get that information into a form that is understandable to the people to whom you want to get it, and how do you instruct them. One of the problems that the government has is that it is not a credible source of information. Now most of my work has dealt, at least in the last two or three years, with the industrial sector, and I think Mike made some excellent comments in terms of how industry responds to the federal government. They are not particularly interested in it.

So in terms of looking at various kinds of incentives, I think you first have to sit down and say, okay, what kind of incentives do we have, what can they accomplish, how do I target them, how do I tailor them to what it is that I want to accomplish, and then, most important, how do I begin to implement them, because you can talk about a tax incentive, or you can talk about an information dissemination incentive, but if you don't implement it correctly, you might as well just have been shooting into the wind. It's not going to be any good. I think yesterday Tom Sparrow in his results of the workshop mentioned a couple of implementation

problems. You look at the IRS as an implementation vehicle for tax incentives. Its a low administrative cost. It is an existing institution. Those are elements that can reduce the cost of trying to get that incentive out there. The same with the networking, you want to look at institutions and go with mechanisms that will ease implementation. You want to use trade associations in industry, for example. If you are dealing with small communities, you want to go to their trade associations, to their particular interest groups, their creditable sources. In the general market sector, the residential sector is much more difficult. There is almost no one to turn to. There have been some very good studies done in California looking at consumer behavior. In one case study on those who purchase solar, their neighbors, who did not buy solar, were examined to find out what the differences were. What influenced them? What were the reasons of the people who did not buy solar? A lot of that, you'll find, gets down to the timing of the incentives. It's not only the timing of the incentives, but as we all know from our diffusion curve, there are different people who are going to be buying at different times. And it may be that you will have to time your incentives, or change your incentives, as you move through the spectrum of the various technologies in order to try and capture that next incremental group of people. For that incentive might be the one that is going to get them to come on-line. If you look at a tax credit, for example, the tax credit really is going to be for someone that is kind of on the borderline. They've thought about solar, they are ready to go, and the tax incentive just gives them an addition reason. It might, for others who haven't thought about solar, start them thinking about it, but it's probably not going to be the thing that will push them over the line to buy the solar system.

These are the kinds of things that you just have to examine. An interesting thing that has come since we've been working, just within the last two months, has been a solar pond. Solar ponds have been around for a long time. Everybody has been talking about them. They're nice and they're wonderful. You are still talking about operating temperatures about the same as the flat plate collectors, and it's been basically ignored through most of the solar program. We've had forty-two inquiries

from industry in the last month on the use of solar ponds; we've had six complaints from people who have said "Would you please come in; we are willing to pay you without government money to come in and give us technical direction on how to put in one of these solar devices." What happened? Industry people don't know about it. As a couple of industry people have said, "There's 95% of my industry has never even heard of solar." So, how do we begin to get some of the word out?

And, again, here's a technology that has been around, we've all heard about it, we've all talked about it, there have been advocates, but never manufacturers. No one has manufactured the solar parts. Workers haven't been trained to produce devices. Maybe it is made up to the user to demand the good, but if you look at it, a lot of industry has the capability to use solar goods already. For example, many have a pond already there. They are using it for a duck pond, for decoration, or for some other purpose. With minor modifications and very incremental additional costs they could use it for low-temperature heat or for generating electricity. But they're not doing it because no one is manufacturing or producing the necessary solar devices.

Israel has an operating solar pond for generating electricity; it may be only 10% efficient, but the fact is it's an industry; they've already got 95% of the pond there.

We've got to start looking at solar technologies that are almost there, begin to push those and get those out; and the second thing is looking at the industries or the market sectors where there really is a need for that energy now. There's a bias towards energy intensive industries who want large quad impact, but in terms of developing the technology they may or may not in fact be the best way to try to get the initial solar systems in. It is something we can't predict. For the industrial sector we have seen, we're talking about the steel industry and the hydraulic cement industry and the glass industry and the paper industry and food industry and all of these, with the exception of the food industry, I'd say all the other major energy intensive industries, probably are not really good markets for solar. The paper industry can be pretty much self-sufficient; the others are pretty much incapable of using

solar. The food industry has some problems in that it is a highly seasonable activity, but there are a lot of smaller industries, smaller applications--50% of most of the industries surveyed in California use solar generated hot water. It is not a technology that you can categorize in the ITC report, or the Battelle report, or whatever other reports there are. All of this points out that it is important from the beginning to look at your market.

I think Bill Babcock mentioned yesterday the fact that we need some better data, but I think in part it may not be the data itself, it may be how you look at it, that is important. From my perspective the following is important: (1) Look at what the incentives are, what they mean, and how you can begin to assess what the impact might be, how you implement them. There is a major discrepancy between how Congress allocates money and how programs implement. You have to take dollars then and begin to run a program. (2) There is a lot of inconsistency in government policy, particularly as far as industry is concerned. One year it's here, one year it's there. You put in a regulation that could be repealed next year, you put dollars into a program; industry commits its monies, but there is no budget for it the next year. That's a very uncertain type of environment and you are certainly not going to get a tremendous amount of cooperation from particularly your investment partner. So I think more than anything else, in addition to all we've been talking about today, the whole activity or the idea of implementing these incentives and what you mean by them is what we need to consider as well.

JAPANESE EXPERIENCE WITH GOVERNMENT INCENTIVES

James Maxwell

I am going to shift the discussion abroad for my talk. I have been working on several large projects that have been examining industrial policy abroad and technological innovation. So I am going to make a few remarks on some Japanese industrial policies and their implications for the development of industrial policy toward solar energy. As Rosalyn said, and other people have suggested, it is important not only to examine past incentives in the U.S., but examining policies abroad might also give some clues on new and better ways of developing incentives for the U.S. energy program. Japan is an interesting case because Japanese industrial performance has been very dramatic across a number of industries. And another unique aspect of the Japanese experience is that this has been achieved with extensive government intervention in the industrial sector.

Now, quite a large amount of data and studies have been examined about the specific policy mechanisms by which the government has intervened in the Japanese economy. And what I would like to do is basically, as we've gone through the incentive stuff, describe some of the specific steps that the Japanese government has taken to encourage not just solar development but industrial development generally. A brief historical backlog to this is necessary. As most of you probably know, Japanese economy following World War II was not in the greatest shape, and following World War II the Japanese government made some decisions on designating certain industries as key industries. They selected industries on the basis of several criteria, one of which was whether the industry had a major export potential. The other was that they wanted industries which involved manufacturing and employed large numbers of people and had potential for expansion. With the unique legal system that evolved in Japan, Japan passed a series of what are called basic laws. These basic laws set up a legal framework for the government to intervene in the activities of a particular industry. For example, in the case of agriculture, there is a law called The Fundamental Law for Agriculture, which gives the government authority to intervene in a large number of areas of agriculture. The laws that follow have to be consistent with

this framework. This is just one of many laws. The basic laws set up methods they have used to intervene in most areas of industrial development.

Most of these actions taken by the Japanese government are in the area of three administrations: International Trade and Industries, Administrative Finance, and the International Planning Agency. These are the three super agencies in Japan, and now I would like to briefly go through and describe some of the more specific incentives that they have given to industry. For instance, most people are probably now familiar with the fact that the Japanese government has taken a number of actions to protect Japanese industries from competition abroad. Some of these actions include, obviously, protective tariffs. The commodity taxes in Japan are also very discriminatory against imports of foreign goods. They use import restrictions by means of foreign exchange regulations. More in line with what we've been discussing, here, the Japanese government has taken other more concrete action to spur industrial development. One of the things that Barbara mentioned and which the Japanese have done to a large extent is that they have given low interest credit subsidies for public financing companies from at least nine different agencies in Japan. The Japan Development Bank, the Export-Import Bank, the Small Business Corporation, to name but a few of these, have made public financing available to designated industries. So that's one of the most direct incentives the Japanese have given to all their industries.

Japanese have also given direct grants to industries. The level of the direct grants is determined by both the basic laws which I described and a series of other laws that are industries specific. There is also, I don't know how closely people have been following things like the auto trade issue, but the Japanese also have a special taxation measures law, which gives industries special depreciation, which is quite a bit higher than the depreciation allowed in the U.S. So that's one kind of tax measure.

They also use another tax measure that encourages industry and research and development. That is, there is a tax credit in Japan of 25% for any kind of research and development expenditures. Strangely enough,

the Japanese have made little use of direct subsidies for research and development. In fact, although people talk about the strength of the current Japanese auto industry, automotive technology has barely been subsidized at all. What subsidization has occurred has occurred through the tax system to research and development.

The Japanese also make use of regulations and these regulations are what you get in the U.S. They use regulations to set prices and fares and also to control and limit the entry of firms into market. They also use a number of regulations to deal with the externalities of rapid economic growth. They've used these in cases like pollution control. The regulations briefly mentioned serve as an outgrowth of Japanese regulation. Japanese regulations in the auto industry, for instance, regulate emissions and control fuel economy. And, in our interviews, Japanese firms have said that the understanding they gain from trying to comply with emissions control regulations has led to their development of more fuel efficient cars. Another major difference between the Japanese use of incentives and use of incentives in the U.S. is the importance of voluntary actions like people mentioned before--administrative guidance in the form of directives, advice which is meant as notification of opinions. In Japan, you sort of lose face if the government needs to tell you to take some sort of action, and companies don't disobey, because they lose face with the public and lose part of their credibility. And this administrative guidance, or what Rollie calls exhortation, in Japan is based on direct legal authority. In other words, there are certain laws, like the laws that establish the Administration of International Trade and Industry, that give broad powers to promote and interfere in all kinds of industrial affairs.

One of the major differences perhaps between the U.S. and Japan is this difference in regulation. There is less difference between regulation and exhortation in Japan than there is in the U.S., because, in fact, many of the laws like the recent fuel economy regulation for automobiles in Japan have no sanctions whatsoever. So they must be considered voluntary guidelines.

I would like to suggest some implications from looking at Japanese industrial policies for solar. I think one of the things we haven't discussed here is whether international trade considerations should be incorporated into industrial policies toward solar. The thing that the Japanese have done with all their industries is to see how they could promote the development of the industry in a world market, not just within Japan. That is one question we haven't discussed yet in this workshop. Another question I think that comes out of analysis of Japanese industrial policies is whether a tax incentive for research and development should be enacted. The third is that the Japanese have had problems as well as successes with their industrial policies. One of the problems they've had is once the various incentives have been put in place, how do they get rid of them. That was the question we were dealing with yesterday when we were talking about "sunset" clauses. I think another unique thing that has come from the Japanese experience is they have managed regulations. More research can be done in this area as well.

SUPPLY VERSUS CONSUMER INCENTIVES

Michael Saba

First, though this conference is extremely important, it should have more visibility and should try to bring in more people from industry; particularly people who would be movers and shakers.

I have been involved in launching four different businesses in my career. One of them now is a hundred million dollars in size. My experience consists of systems, products, computers, and services. In light of these experiences, I would like to give some ideas about the differences between the supply and the consumer sides.

One of the things that must be done before a business is launched is to look at what others have done. The mistakes and successes provide considerable information. In the Battelle report on the nuclear industry is discussed and how incentives were used to build it. When one studies it, one must admit that it was primarily built from a supplier side. It was built because the government had a long-term interest in it, probably for national security, but nevertheless neither the industry nor government had the people who were actually the consumers involved in it. The suppliers built an industry based on the technology and it has now gotten into trouble because it did not make the consumers a part of it. As a result, the safety issue exists today and accounts for the nuclear industry slow-down. It may recover in several years because technology will have advanced.

In addition, one more thing you should realize is that the first company into a market is usually the company that gets the significant share of that market, and continue to hold that market share as other competitors that enter into the later market have to partially displace them from that share of that market in order to be able to gain foothold. The second people in market are usually less profitable. They may become marginably profitable but as time goes on they will eventually get out of the industry unless they can take away a large enough share from the major or initial company.

Examples in the nuclear industry are Westinghouse and General Electric. They sold boiling water reactors first and that was what the utility industry selected. Thus they gained the market. Take a look at General Atomic, who came in with the HTGR. It never went anywhere even though it was a much more advanced unit. It was more efficient and also performed better. They sold only one or two units. One must learn from examples like that.

In our work at Theodore Barry and Associates, we are very heavily involved in the utility industry. We have ongoing relationships with the chief executive officer of about ninety utilities ranging from TVA to American Electric Power. This covers about 80% of the nation's generating capacity. Ninety-five percent of our work is done in the private sector.

As many of you know, one of the major problems facing the utilities today is their profitability. In most of investor owned utilities, stock is selling below book value. Though utilities are allowed earnings of about twice of what their stock are currently selling for, rate of return is still considerably lower than the rate industries such as steel, paper, or whatever, can get. So, there is considerable concern about keeping from being nationalized, or at least from being listed on the endangered species list. They are extremely concerned about their future.

Many of the chief executive officers of utilities are looking for ways in which they can meet the requirements of their franchises to deliver electricity and remain profitable. We are helping them look at alternative investments, specifically, alternative technologies in the solar field.

The utilities have a need; they will buy suppliers equipment now. It seems that the problem is that suppliers are not able to believe this, especially those suppliers who have not been traditional suppliers to that industry. Lets take an example of say Martin/Denver. Martin has not really sold many products to the utility industry so it is really not recognized as a supplier by utility management. Moreover, the utilities are not certain that Martin will make a commitment to the long term service of the products it sells. So there is a certain amount of lack of credibility. As a result, there is a arms length relationship and thus a

hold-off in making those investment decisions. Martin by the same token isn't going to invest capital money into plants and facilities. The bottom line is bringing these people together and exchanging these ideas.

The key to this is that the consumers are the ones who prompted and supported this demand that the utilities are now seeing. For instance, the utilities that have been most successful with their solar energy have interested their consumer in investing and making that decision. Consumers are not concerned about what kind or type of generating capacity utilities will use. They are concerned instead about what it is going to mean to them as individuals either in the bill from their utility every month or a tax credit.

One of the things we feel needs to be done with incentives is to structure them more from the consumer side than they are today. For example, Wisconsin Power and Light set up new incentives with regard to their customers and their service territory. They ended up having these people respond very favorably to buying equipment, because they had a choice. They could put it in themselves or buy it from the utilities on a no-interest loan. I think if we are able to develop those kind of things much more effectively, that is making the consumer a part of incentive structure, we will create a demand from the consumer side. Once that demand is created, industry will follow and put the investment in place in order to deliver a product.

I would like to read to you about three different rate ideas where the incentive will be directed toward the consumer side. First is the establishment of an electric rate which recognizes a system favorable for a demand profile with supplemental or standby power purchased by solar customers. This is called a cost-based rate. The second would be to provide a cash grant from the utility to the solar user to preserve the latter system benefit by reducing conventional plant needs to the extent that solar installation displaces such plants. The basis of this system benefits derives from the fact that if the solar unit was not in place the utility would have to provide an additional level of demand that would cost in excess of revenue received due to the fact that the indebted or average cost base rate did not cover marginal costs in an inflationary

environment. The third approach is to provide the customers the option of the utility participation in solar plant ownership at a level equivalent to the marginal cost of the displaced conventional plant or to the discounted future cost of the energy saved by the utility. The object of this approach is to establish a mechanism for reducing the front end investment for the burden of a solar installation.

If you have any questions, I would be glad to answer them. Thank you for the opportunity to participate in your conference.

CHAPTER IV

DIVISION OF \$41 BILLION AMONG INCENTIVE TYPES

DIVISION OF \$41 BILLION AMONG INCENTIVE TYPES

As a "point" of departure," discussed at the end of the paper presented in Chapter II, a budget for Federal incentives for renewable resources of \$41 billion from 1980-1999 was proposed. The participants in the workshop were assigned to groups to discuss this proposition and to examine the role that various incentive types might play. Distribution by incentive type and timing of the incentives were also discussed. The separate sessions were on taxation, requirements, market activity, and services/disbursements. The results of each group session were summarized by a rapporteur from the Battelle team for presentation in this volume.

Services/Disbursements

Robert Sears - Chairman
Bill Babcock
Rosalyn Barbieri
Jeff Hammarlund
Michael Saba
Harold Harty
Paul Sommers - Rapporteur

The services and disbursements group supported federal research and development programs for solar, but did not see a lot of scope for other kinds of services and disbursement to the solar industry. While solar technologies do not seem to require the amount of R&D that nuclear technologies require, there does seem to be a role for the government particularly in basic research and in demonstrations of technologies that are too risky for the private sector to undertake. There was agreement with the statement that the appropriate research and development projects for the government to fund are those that private industry will not undertake on its own. However it was noted that the government may tend to emphasize different kinds of projects than the private sector would because of the short tenure of government actors and the different sets of goals related to the public good that the government actors embody. Concern was expressed for protecting proprietary rights of private sector participants in government programs. Demonstration and R&D contracts need to be structured so as to protect the proprietary interests of private sector participants. There was general agreement that satisfactory mechanisms exist for doing this.

A broad R&D support program was recommended. It was stated that the government should not support specific technologies or applications to the detriment of others. It is the market's job to choose among a portfolio of technologies. The government should develop every technology to some comparable point and then turn them over to the market which will make decisions about whether or not to actually utilize the technologies.

There was extensive support for some sort of mechanism to provide long-term, sustained funding commitments for R&D programs. One year budget cycles are not appropriate for this kind of work.

In the services area, it was suggested that the government could provide land use designations to facilitate development of solar sites. This could involve either setting aside public lands for use for solar facilities, or designating land or possibly buying it up in urban areas to provide locations for solar facilities. Government information programs are another important service. The government can get the information about solar technologies out to potential users. However, it was maintained that the government itself has rather low credibility with potential users, and that a government funded report appearing the under contractor's letterhead is better than the same report in a government folder.

There is no support in the group for the use of disbursements of subsidized solar technologies. In general, the group favored R&D, and a few other services, especially where public goods issues are involved. In general, the group wanted to let the marketplace make basic decisions about utilizing solar technologies, after the government had developed the basic concepts to a marketable point.

Taxation

Tom Sparrow - Chairman
Roger Bezdek
Sarah Glazer
Jim Maxwell
Bill Sheppard - Rapporteur

The definition of taxation as an incentive was reviewed. The role of taxation as a means to raise revenue, to redistribute or transfer incomes, and to discourage certain private sector activities (or encourage them by remission of taxes) was commented on. A brief taxonomy of taxes was then developed.

Lessons for Solar from Incentives for Traditional Energy Form

- (1) Sunset clauses or a declining benefit schedule should be built into those incentives programs that are needed only to get the industry off to a good start.
- (2) The public and recipient groups do not regard tax credits as welfare payments. This makes tax programs more acceptable than handouts. However, they are somewhat "invisible" and hence hard to measure in any cost-benefit analysis. Also annual budget review is not possible.
- (3) Tax credit systems are moderately easy to administer and enforce. The social effect tends to be regressive if income taxes must make up for the taxes foregone. However having the IRS administer subsidies leads to very conservative regulation.
- (4) Just as the incidence of taxes can be shifted, the incidence of subsidies can be shifted. These effects should be anticipated and planned for in advance.
- (5) There are speculative dollars that will move to the "best deal" such as oil drilling and real estate. This source of funds can be tapped by appropriate incentives ("Solar investment trusts").
- (6) Tax incentives do not always aid those needing encouragement and may be a windfall for those who would have done the same thing in the absence of the incentive.
- (7) One man's incentive is another man's tax loophole, but this is not bad if the societal goal is achieved.

- (8) Investment tax credits and depreciation will be helpful for OTEC and power towers as well as distributed solar energy devices since these are capital intensive.

Additional Incentive Designs

- (1) He who benefits should pay. If national goals are achieved by forgiving local property taxes, federal money should be given the local jurisdiction to replace the lost funds. (Property taxes on solar have an inhibitory effect because they go on forever and will keep up with inflation.)
- (2) A Btu tax on scarce fuels will help reduce fuel use. If the receipts are used to finance solar a double impact will be obtained.
- (3) Proposals for incentives should be backed up with analysis of downstream impacts--additional jobs, scarce resources used, future tax revenues as well as taxes foregone.

How Much Tax Incentives vs. Other Incentives

- a. The level should remain high since it gives individuals economic choices.
- b. But not too high because of loss of revenue.
- c. A balanced program of incentives is needed to reach all types of recipients. There is a need for balance geographically by income class, shortrun vs. long run, timing in product cycle etc. Taxation is an important incentive but not the only one to use.
- d. The present 55% allocation of subsidies to taxation incentives is probably acceptable.

Market Activity

Jon Veigel - Chairman
Ray Anderson
Gerry Bennington
Arthur Reiger
Mike Shulman
Dave Lenerz - Rapporteur

The first part of the discussion dealt with the meaning of "market activity" incentives and the proper role of government in the market. It was generally agreed that market activity included market research, development, and stimulation. This includes actions aimed at the entire distribution channel, as well as efforts to aid solar production. In order to focus the discussion, it was proposed that government market activity incentives could be categorized as follows:

- (1) Direct government production or consumption of solar equipment
- (2) Government aid to firms engaged in producing, selling, installing, etc. solar equipment
- (3) Government action to achieve positive decisions and positive experiences by consumers.

Although some group members found this classification difficult to work with, it was retained for discussion purposes.

The greatest portion of the discussion pertained to the proper role of government in market activity. There was general agreement that the federal government ought to limit its role to those things it can do well and/or those which are necessary in order for the private sector to function properly; however, there was a variety of opinions regarding what this would include. Major points made by the group members included the following:

- (1) The government's role is tenuous; what can the government do and not get in the way of the private sector?
- (2) In the industrial sector, there is a limited role for government since business knows what it is doing.
- (3) A new government TVA type organization for solar energy is opposed.

- (4) If solar energy is not economical (in broad terms), then the government shouldn't promote it.
- (5) As producer/consumer, government has a role in centralized solar technologies.
- (6) Because TVA, BPA, etc. do exist, the government naturally does have a role in market activity.
- (7) The government's major efforts should be directed toward RD&D (not a market activity).
- (8) The government is not monolithic; it is not flexible; it cannot act like a business.
- (9) Where the government has been most successful, it has utilized existing institutions, e.g., county extension agents.
- (10) The government should not get into the business of producing solar equipment.

Having discussed the proper role of government in market activity, the group next tried to answer the question "What lessons from traditional energy incentives can be applied to solar energy?" The following major items were agreed upon by most group members.

- (1) Past incentives patterns don't provide a good guide for the future.
- (2) Some types of incentives shouldn't be repeated since they haven't worked well.
- (3) Incentives should be aimed at the point where the market isn't working.
- (4) Timing of incentives is very important.
- (5) If solar energy replaces fossil fuels, the government saves the cost of traditional incentives.

To discuss the question "What market activity incentives should be used?", photovoltaics were used as an example. Group members made the following major points:

- (1) Government purchases to "pull" solar aren't appropriate until the technology is adequately developed.
- (2) If industry has already committed itself to a solar technology, there is a limited role for the government.

- (3) It is questionable whether the government should promote a specific technology through large scale purchases.
- (4) If government is going to stimulate the market by buying solar, it should be a long-term commitment.
- (5) Government incentive purchases should be phased out when the market reaches a certain size.
- (6) Government should be a consumer to test the product under various conditions.
- (7) Problems with government purchases are:
 - (a) standards (specifications) may not be suitable for the general public
 - (b) the government may not use the same evaluation criteria as the typical consumer

The final area covered by the group was allocation of the incentives budget. The highest priority items turned out to be demand stimulus for decentralized systems and direct government purchases of centralized systems. Specific suggestions for government action included: (1) collection and dissemination of solar data, (2) government purchases through normal procurement channels, (3) putting solar collectors and monitoring equipment on every post office, and (4) subsidizing the power authorities' purchase of centralized solar systems. There was little trust in government decisionmaking and so maximum decentralized market choice was advocated.

Requirements

Alan Miller - Chairman
Richard Chew
Barbara Euser
James Spensley
Alfie Marcus - Rapporteur

Historical incentives to traditional energy sources may not be a relevant analogy for future incentives to solar energy. Historical incentives to traditional sources involved the purchase and sale of the resource, while incentives to solar energy will involve utilizing this resource. Historical incentives aimed to change the behavior of manufacturers and to increase production. Incentives to solar have been aimed at consumers to raise demand. Therefore, it is difficult to make analogies from past incentives to solar energy.

In addition, requirements generally are not incentives but disincentives. They restrict price, control entry, affect the introduction of substitutes, and limit certain business practices. Incentives, on the other hand, are more likely to be government activities such as loans, and loan guarantees, price supports, and R&D grants, which give the investor an edge. Rewarding private parties for pursuing certain activities may be more effective than requiring that these activities be performed. Still, certain requirements may be used to stimulate solar energy use: for example, the requirement that new housing be built with solar hot water heaters that conform it to certain standards.

Requirements, such as the one to impose solar hot water heating on new buildings, look attractive to the government, because they seem to involve small outlays and promise large impacts. But there is a problem of who ends up paying for the promised benefit. Usually, this is the consumer. Industry passes the cost on to consumers. This often necessitates subsidies to low income people who cannot afford the additional costs of new requirements. Thus, although requirements may appear to politicians to offer substantial leverage--(small government outlays that produce major behavioral changes); in reality, they must be monitored carefully for economic impact--for their effect on equity and

efficiency. From an economic standpoint, requirements should be used sparingly because they can produce misallocation of resources.

Another problem with requirements is that they are centrally mandated. Central control may be appropriate with respect to stimulating the use of coal, nuclear, natural gas, or petroleum. But centrally mandated requirements may not be appropriate for solar--which is a decentralized energy resource. For all these reasons, it is difficult to make the leap from the past--to take past incentives historically granted to the production of traditional energy and to apply them to solar energy.

Requirements that the government could impose to promote the use of solar energy include the following:

- * Building permits could require solar design;
- * Solar hot waters could be required on new homes;
- * Factories could be required to use solar energy for pollution reductions in order to obtain "offsets" (in areas that exceed natural standards);
- * Utilities could be required to buy power from small solar producers;
- * States could be required to give higher rates of return to utilities that produce a certain percentage of their power from solar;
- * Federal installations could be required to use solar hot water heaters;
- * Utilities could be required to do audits for the purpose of facilitating consumer use of solar devices;
- * Fuel conversion legislation could require that those who switch from conventional fuels use solar;
- * Utilities (public and private) could be required to produce a certain percentage of their power from solar;
- * Zoning requirements could mandate siting for maximum solar use;
- * Federal installations could be required to do life-cycle costing when making fuel-use decisions
- * Licensing and other requirements could be expedited for solar energy users;

- * Professional licensing requirements could mandate solar energy expertise for architects and others involved in building.

There are important reasons why the government should not create consumer standards for solar equipment. Such requirements would tend to restrict innovation and limit entry. Larger and better established companies would be able to use standards to eliminate competitors. However, consumers may need product standards to increase their confidence that they are purchasing satisfactory equipment.

In general, the government should try to take advantage of the existing regulatory framework, rather than creating new laws or regulations. In addition, it should be very cost conscious when it makes use of requirements. This is so because someone in the private sector will have to bear the major proportion of the costs, not the government.

CHAPTER V

DIVISION OF \$41 BILLION AMONG END USE SECTORS

1. The first group of students (Group A) was assigned to read the text and identify the main idea of the passage. They were then asked to write a short paragraph summarizing the text in their own words.

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DIVISION OF \$41 BILLION AMONG END USE SECTORS

The "point-of-departure" proposition that \$41 billion be spent on incentives for renewable energy from 1980-1999 (Chapter II) was discussed in small groups from the point of view of the end use sectors. Relative effectiveness and timing were part of the discussion. The end use sectors were Residential and Commercial, Transportation, Industrial and Agricultural, and Public Sector. The results of each group session were summarized by the Battelle rapporteur for presentation in this volume.

Industrial and Agricultural

Gerald Bennington - Chairman
Roger Bezdek
Harold Harty
Michael Saba
Robert Sears
Paul Sommers - Rapporteur

This group considered the use of wood and solar thermal technologies, and alcohol fuels in agriculture. There was general agreement that wood technology is well developed and that people understand how to use it. Thus, the group concluded that no incentives were needed to facilitate wood use in industry.

With respect to solar thermal technology, it is the consensus that no industrial process heat program exists in DOE and that this is a major gap that needs to be filled. It was maintained that industries are not concerned with optimizing their energy facilities. In making their investment decisions, they are mostly concerned with survival. Thus in order to make solar thermal processes more appealing, incentives which radically alter the pattern of cash flow and thereby affect survival probabilities would be most affective. One such incentive is accelerated depreciation rules. Another incentive suggested was to take the risk out of solar entirely for industrial users by setting up energy companies which deliver energy from solar sources, and thereby assume the risk of developing these new supplies of energy. Third parties such as existing utility companies or existing oil companies could develop into broad-based, renewable energy companies. Government could be helpful in encouraging this development. The group recommended use of investment tax credits and accelerated depreciation as incentives for solar/thermal processes. There was no support for loan guarantees. Some regulatory requirements were favored though none were precisely specified by the group. One interesting idea suggested was to provide property tax exclusions for solar equipment, coupled with reimbursement programs for local governments. Thus, solar processes would receive an incentive but at the same time the local government jurisdiction would not lose any revenue.

In the agricultural sector, it was suggested that property tax and land exclusions may be good incentives for the federal government to use. Existing extension services were favored to provide information and R&D support for solar. Once the technology is proved and demonstrated to the satisfaction of agricultural sector, existing economic decision makers will decide whether or not to use it.

The group favored allocating incentive dollars in proportion to energy use in the two economic sectors. Thus, about 70 or 80% of the dollars should go to industry, with the remainder going to the agricultural sector.

Transportation

Mike Shulman - Chairman
Bill Babcock
Barbara Euser
Dave Lenerz
Jim Maxwell
Alan Miller
Tom Sparrow
Bill Sheppard - Rapporteur

Solar energy for transportation is primarily ethanol from biomass in the short run. Also possible is methanol or gasoline derived from methanol and, as a diesel substitute, vegetable oils. Photovoltaic electric units on vehicles and charging of stationary batteries for vehicle use were excluded.

There was some concern about the food versus fuel if grain is used as the feedstock. (Until cellulose hydrolysis is commercially viable, corn, sugar cane, and other food products will likely be the source of ethanol.) Some felt we should maximize the thing we do best, namely raise food, then use the money for oil. Others felt national security and balance of payment problems made it desirable to have incentives to encourage liquid biomass fuel.

Several matters-of-fact were discussed.

- (1) A large coal based plant can produce methanol cheaper than a biomass plant.
- (2) Economics of scale drop off quickly in scaling up biomass projects.
- (3) Fermentation removes the starch but leaves the protein, thus the most valuable part is left for food or feed use.
- (4) The energy inputs and outputs just about balance. If coal (or solar) is used for energy, a contribution to reducing oil imports is made.
- (5) It would take 2/3 of the U.S. corn crop to make enough alcohol to replace 10% of our gasoline use.
- (6) Importation of Brazilian alcohol at \$1.50 per gallon is counterproductive.

Present incentives for biomass ethanol are considerable. (Appendix G of the report gives \$5.65/million Btu, 1980\$.) The size of the subsidy for hot water heaters and space heat is of the same magnitude (Appendix G gives \$5.66 for space heat and \$3.86 for water heating, in Columbus, Ohio; Phoenix might be half this for water heat.) There was a fear that subsidies of \$4-5/million Btu were becoming institutionalized. The group felt that small scale on-farm production is desirable to help farmers be energy independent, which is especially valued at planting and harvest time. For large producers, the most important excuse for the program is to aid the farmer. The current level of subsidy was felt to be high enough to encourage ethanol production. The group was about evenly divided as to whether it was good to continue the program for large scale ethanol production. (Government ownership of the plants might be a good way to be sure the plants were not operated when food grain costs are high.)

Conservation should be pursued in any case. Two tune-ups per year might save as much gasoline as the gasohol program.

Residential and Commercial

Bill Babcock - Chairman
Barbara Euser
Jim Maxwell
Alan Miller
Bill Sheppard
Mike Shulman
Tom Sparrow
Dave Lenerz - Rapporteur

The discussion dealt with three main topics relevant to energy incentives in the residential and commercial areas. These were (1) lessons from past incentives, (2) problems to watch out for, and (3) the tradeoffs between conservation and solar energy.

From the results of past incentives, the groups found that few lessons could be applied directly to solar energy.

Residential and commercial solar energy technologies are very different than technologies based on fossil fuels. Based on the few similarities which do exist, the group felt that (1) timing of incentives is very important, (2) REA type activity could be transferred to the solar area, and (3) a Btu tax on fossil fuel to subsidize solar energy would be very effective.

The group found that the past use of incentives has shown that certain problems must be addressed. These are:

- (1) Government action should be directed in such a manner as to not freeze technology at a given level.
- (2) An incentive is likely to be more effective if existing channels of communication and distribution are utilized.
- (3) If utilities are used then (a) buy back rates need to be set at the proper level, (b) it may be appropriate to subsidize utilities which support solar use by their customers, and (c) utilities gain from solar use and this should be factored into their rate structure.
- (4) Every aspect of buildings' use of solar must be addressed or bottlenecks may occur, e.g., untrained code enforcers.

Finally, it was recognized that solar energy and conservation serve the same purpose. Greater conservation may reduce energy consumption to the point where solar becomes less economical. If building efficiency standards are set (BEPS), and if solar costs more than conservation up front, then builders are likely to choose conservation over solar (even if solar makes sense over the long run).

Public Sector

Richard Chew - Chairman
Ray Anderson
Sarah Glazer
Jeff Hammarlund
Jon Veigel
Alfie Marcus - Rapporteur

The public sector was viewed as: (1) strictly government bodies (federal, state, and local); (2) schools, hospitals, and other non-profits; and (3) public utilities and public power generating facilities. A total of \$38 billion could be spent by the year 2000 to stimulate government use of solar energy. Market activities and disbursements in three categories were considered relevant: (1) purchase of solar generating equipment for use by public sector buyers; (2) purchase of this equipment for use by someone other than the buyer; and (3) purchase for housekeeping activities such as heating and cooling. The following table illustrates how the money could be spent:

Market Activities

Buying for use	\$ 1 billion
Buying for use by others	\$ 2 billion
Buying for housekeeping	\$ 15 billion

Disbursements

To federal agencies	\$ 10 billion
Passed downstream	<u>\$ 10 billion</u>
Total	\$38 billion

The basic philosophy behind such an allocation is that the public sector should provide a role model for other sectors. It should build and have on-line solar operations and should use solar power from its own housekeeping needs so as to gain the experience necessary to assist others who wish to adopt such methods. Solar installations in visible locations

in schools, offices, and post offices will create an incentive for emulation of the public sector.

Requirements such as life cycle costing based on marginal cost pricing should accompany market activities and disbursements. Other requirements, such as not permitting hospitals to get federal grants unless they use solar application, also might be considered.

The government should aim to produce the equivalent of five 1000 mgw power stations, which generate electricity through a combination of solar methods (collectors, towers, wind, biomass, etc.). The government should pay the differential--or the perceived risk of using solar in comparison with other forms of generation. At \$100 per kw, these risks might come to 15 percent, which is \$150 million per system, for a total of nearly \$1 billion. If in particular situations, solar energy had lower perceived risk in comparison with solar generated power, then there should be a revolving fund or recovery plan, by means of which solar power could earn credit.

After completion the government should pass over solar demonstrations and development projects to private parties or state agencies. Or it might buy a large volume of photovoltaic cells or other solar equipment and pass it on to others. These subsidies to solar energy could amount to \$2 billion by the year 2000.

Life-cycle costing and marginal pricing principles should govern public sector housekeeping activities. The discount rate should be set low, perhaps as low as 3 percent, so that the public sector could achieve 20 percent solar use by the year 1990, instead of 2000. Fifteen billion dollars set aside for capital costs should be made.

Disbursements for use would include in-house R&D, and the granting of funds to agencies like EPA, the Forest Service, and State Bureaus of Land Management for biomass activities.

The public sector has to be stressed in all incentives programs so that is perceived as the pacesetter. This will provide credibility for solar power. The \$38 billion figure just for public sector incentives suggest that a \$41 billion total for incentives to all sectors is insufficient.

CHAPTER VI

AN AGENDA OF FEDERAL INCENTIVES TO ACHIEVE
18 QUAD OF SOLAR BY 2000

AN AGENDA OF FEDERAL INCENTIVES TO ACHIEVE 18 QUAD OF SOLAR BY 2000

Bruce W. Cone: We enter the final phase of our workshop this morning. The purpose of the final phase is to see where we are on this journey. We started this whole effort dealing with historic incentives four years ago. Four years ago, I quoted my favorite politician as setting the standard that we wanted to pursue. Mr. Lincoln said at the outset of the Civil War, "we must determine where we are, and whither we are tending before we can decide what to do and how to do it." It's a quote I've used periodically through the past four years because I think it fits absolutely what we're trying to do with the analysis we've presented here.

Roger mentioned in his opening remarks that it was to our amazement that the United States had thrashed around an energy policy for three or four years before we commenced our work, and nobody had ever asked the question: What was the partnership between the federal government and the private sector that gave us the energy that we have? Now we have done that. Four years later we have a series of big thick reports. We have had interaction with a wide number of people. So we are, literally, in the final phase of this program. If, in fact, we are going to conclude this work, we want to bring it to a close in such a way that people can understand what we have done. That was one of the principal reasons for this workshop. We think we have put in the public domain, a description of the tools that are available, and the results of those tools. We hope there are some fresh ideas incorporated in our work because of this conference. We know that the mix of incentives is important, the timing of funding must be considered, and a commitment is necessary. We also know that the commitment must be measured in more than dollars.

What should be our agenda for the future? What should be the role of the federal government in stimulating solar policy? These are the questions of this morning.

Michael Saba: First, any incentives should be made on a declining basis, such that they should have a time in which they would be completed or be

removed. That's been one of the problems with past and existing incentives.

Second, local recovery of tax should be evaluated, because it represents a very strong boon to the application as it returns those dollars back to the local government and people who lose them as a result of a Proposition 13-type of activity.

Third, it is extremely important that the results of this project be sent to very important decision makers in industry in this country since they are not represented here. If this program is to succeed, we must get these people involved. Until this happens, they're not going to make any decisions and we are never going to get this thing moving. If incentives were important to them, they would have a representative here to take the incentives back to their company and use them as an opportunity for improving financial performance. If they can see a chance to build a business because there's incentive opportunity, they're going to put an investment in to make that happen.

We have spent four years on this, but we're not there. I don't believe this project understands the institutional factors on which people make decisions to fund companies or to buy things. Unless these people attend and pick this up and support it, we are not going to get the thing going. We're just circulating around, but coming from the industry, I can tell you that if industry can see a chance of something happening here, either to sell the stock or make some money, they are going to send somebody; and there's a reason they're not here.

Let me just paint one other scenario for you to please think about for a minute. President Carter was elected partly on the platform that solar would provide a significant part of our energy. He spoke to largely unknowledgeable people; it sounded great, and they thought it would be a good idea, and they voted for him. Now solar's in place and they are waiting for him to communicate to them how solar will do the job. The problem is that solar is not doing what he promised it would do and it's not providing the impact for which he had hoped. So, as a result of that, people are wondering about solar as an energy source, and are becoming disillusioned. Solar is not coming as fast as hoped. I think the

President was partially sold a bill of goods because he was either inexperienced, uneducated, or had a lack of knowledge; and he sold solar as an idea. It brought a lot of votes for him but it isn't delivering. The problem now is that we're still trying to keep things together--even with the incentives and a program maybe isn't appropriate. As Roger says, maybe it ought to wait ten years before it gets its day, even though the people have been promised something free in the sense that solar is free, and that, therefore, their energy problems will be solved.

Jon M. Veigel: It seems to me that unless we have goals that are incentives that are crafted to help us to meet goals, then incentives tend to be a fine tuning or "fiddling while Rome burns." We're not precise enough in the focus of what it is we intend to do. I think Bruce's quote is absolutely appropriate here. We're not careful in what we're doing to bring solar into the reality of our present and future social environment. We tend to be so self-absorbed in getting solar and conservation moved forward that we don't understand or look in as full a way as, I think, we need to at how that matches what society's needs are. People in society are not interested in the moral virtues of solar; they're interested in having an energy service provided for them in a way that meets the needs they've got--living a comfortable and satisfying life that allows them to have energy to work, play, and eat.

We are not organizing our incentives to directly look to nature. Let me back up a little bit. If you are fans of English detective novels, the question that the detective always asks in trying to determine a motive and a culprit is, "who benefits from the crime?" We don't have a crime here necessarily, but we're not answering the question, "Who benefits." We've got to set this thing up so that solar benefits everybody, that is, a part of the pathway from a conceptual design of something to final use of it. I don't think we're looking at it in that way.

I'd like to look at two different sectors where I think we can make something real through our action. We can have some outcomes here. And, I'd like to get off the dime of talking about demonstrations, and fuel tests, and so forth and say we're going to do something. I think that the

circumstance that we're in permits that now. In the utility area, we certainly have a lower growth rate, as TVA is experiencing, and as Mike has mentioned, and we are still going to have construction go on, if for no other reason than to provide the per capita energy consumption for the population growth and to replace retired plants. What I would suggest we do is look to the possibility of accelerating the retirements of the present plants that we've got and institute a target of new and installed capacity for a fraction of intended growth that is going to be accounted for by various renewable resource kinds of installations. And just say we're going to do that; and the actor with whom we're going to do that in special stages is going to be the federal power generating authorities and the marketing agencies we've talked about previously; and I would add to that mix the municipal utilities. This whole set has different accounting parameters to deal with, and are better able to accept a higher degree of risk, than are public utilities (investor-owned utilities) who are fairly well paced by what their PUC's are willing to have them do. The kinds of programs we talked about yesterday, where we can have a hedge program of revolving fund that says, "Okay, we're going to pay you your differential amount of money." And, we can set up a fund that will get some of these things started so they can go into on-line operation as soon as possible.

The last sector I want to talk about is industry. I think, in industry particularly, we're going to see the ability, if we handle it right, for energy to catalyze the renaissance of American industry and I'd like to take advantage of that; I'd like to get energy riding on the back of that tiger. I think it's going to happen independent of energy so we might as well take advantage of it. As I mentioned the first day, I think there will be a lot of advantages to the idea of establishing what would amount to energy enterprise sectors where you would select, say the paper and pulp industry, and you would say, "Okay folks, we're going to go back in there and we're going to adjust all the economic parameters so that it becomes economically beneficial very rapidly for those people to redesign their plants, using maximum innovation, maximum energy efficiency, and maximum renewable resources along the way." And, we'll see what we can do by picking a couple of sectors like that and then dragging the rest of the industrial sectors along, once they see what can be done. I think those

are the two major sectors. Buildings have too many people fussing in it now, and I'm not sure what the answer is in transportation. I think the two major sectors are industry and utilities. I'll stop there.

What I've been trying to do in listening to these comments is try to perceive what are underlying assumptions that people are drawing on here. I think there are a couple. One is that we've had an energy paralysis--an energy policy paralysis--in this country for the last three or four years and there are people who would bemoan that fact. I think that it's exactly appropriate. We are in a watershed with respect to our energy policy and our energy future. We've got more people by orders magnitude than have ever before been involved in or interested in making energy policy choices; and a whole new set of decision factors that have to be considered. So what we're going through is just what we've got to go through; there is no way around it. And to have any other illusions in your mind is an illusion, I think. Also, to expect that the answers will be derived by some rational process is asking for frustration. That's not to say that we're irrational; it's to say that we're nonrational. Congress is what the people deserve. You can make that good or bad depending on your point of view about it, but that doesn't change the facts--they are the way they are. I also believe that it makes a great deal of difference whether an individual makes his judgement about the success or failure of where we are by comparing it to what he expected it to be or comparing it to what it was. I think that people can--we can--wring our hands forever here if we talk in terms of what we thought it ought to have been or what it should have been instead of saying, "Now look, I can remember when California first started in these things, talking to utilities where they thought they satisfied the requirements by having one paragraph in the documents about what solar ought to be, and now they're to the point where there's been enough of a change. They're now getting into it in a reasonably large and significant way and I think that it's based on what it used to be. Because of that I feel reasonably positive about the progress we've made, and disappointed that it isn't better. But, so what? No, we've had progress and it isn't what we expected it to be. I had dinner last night with a guy who is chairman of the board of supervisors of San Diego County and one of his examples was

of the response of the people down there. I asked him how many suits they've had to challenge their solar mandating. Not one. I asked him how many complaints they've had about the systems installed. Not one. And they have found that they are getting some kind of a "riding-along-on-the-shirt-tails" effect because having the mandating down there for the unincorporated county, they have found an explosion of solar installations in the incorporated county, which is not affected in the slightest by this mandating requirement. I talked to some of the people of Bonneville Power Authority who say that what they're getting now is the fact that some of their smaller municipal utilities 10-15 years ago hired home economists because that's where questions were coming from; and that those home economists are now going crazy because they're getting questions about solar which they are not competent to answer, in which a number of questions exceed the questions on how to cook with gas; and they're having to react to that kind of thing. I don't think any of you have had the kind of experience I've had in just riding in a taxi and having the driver ask you what you do and you tell him you're in solar energy--the wash of moral goodness that returned over me is embarrassing! There are expectations that are raised in the body politic out there that can rise up and smite us later. I do agree with that.

Rosalyn Barbieri: Having worked in the industrial sector, I can say that, in fact, the very information that is being talked about here is, in fact, being incorporated in the industrial program itself. And, the decisionmakers are being included in that program and are being consulted. It has been done in the residential sector--a lot of Roger's early work was done exactly due to that. The fact that they're not necessarily included in this meeting doesn't mean that what's being done here is not in fact getting out to industry.

I'm not going to make any particular recommendations, of course, because incentives is not an area in which I've done most of my work. I go along pretty much with what Jon says as far as the kind of things that we need to do. I'd just like to emphasize that I think that you need to look at incentives no matter what sector you are dealing with; whether it's for utilities, industry, the residential sector, or whatever else.

We also have to look at the range of the incentives and, as Jon said, look at the first thing that's going to benefit from that incentive to make sure that your incentive is tailored to the individual as much as possible. In order to implement those incentives, and have them be effective at all, they've got to somehow understand which person is going to take advantage of them. So you've got to tailor the incentives to the user.

In addition to that, from a more programmatic standpoint, you also have to have an ongoing evaluation type of program so that you can go ahead and monitor and see what are the results of the incentives that you put into place. An evaluation program is also needed to be able to make any kind of changes to modify the incentives, if you find you are going off into the wrong tangent. Somehow you must stop and change the incentives, or do whatever you need to keep the incentives working in a way that you best can.

There is something else I would like to say after listening to what we've just been talking about now. As we're looking at this whole energy policy thing at one level, we're looking at it way at the high level where we're trying to influence people in Conservation and Solar, and Congress, and so forth and so on. But I'm hearing from Lee, what I've heard from Bob, what I've heard from people I work with, and getting back to something Barbara said, which is that there's a lot of things that you can do to start chipping a way through, starting at a very, very different level. Here we've got someone who is saying I need some help; they want information. You want to know how to get to the people who know about doing something about solar. I get calls daily at the laboratory asking, "Where can I find out, who is the solar manufacturer, where can I find out about what I need to do; what I need to know?" I get schools calling up asking, "Can you send someone out to tell me about solar energy?" There's a whole series of things that you can do more at the grassroots level, and that's part of what I think we also have to deal with. At the CS level, at the Congressional level, there are a series of things that can be done in terms of trying to develop the policy. But there are also many things that we can do, even at a lower level, and there are many programs that

are actually doing it--where you get out and you start talking about education, information inviting people to things such as this conference. There's another conference going on right here in Seattle looking at energy for the city. There are virtually no people there, other than the city management. Either they don't know about it; they don't care about it; or they're not interested. But there are things that can be done using the existing programs and using USDA and the extension service, which has been very effective in certain parts of the country in pushing solar. Each one of us should talk to other people. It has nothing to do with energy policy as we have been discussing it here; it has to do with a couple of people who are interested in solar and are out there and actually doing it. I think that we also have to look at that in terms of our program now.

Barbara Euser: I thought one of the most interesting things mentioned yesterday afternoon was that if we were going to meet any long-term goal, even if we see solar as a long-term technology, we have to get started now. My own approach is what I call the "instrumental" approach. I don't think there is going to be any great leap forward. So what we need to do, having established a goal, is to start chipping away at the edges. You do that in a number of ways. We need a mix of incentives; but at the same time, I don't advocate any particular mix, but just concentrate on the one I think would have the greatest effect for the money spent. This was the subject of our group on requirements the day before yesterday. In discussing the issues, there are several areas where you can have a large effect for a small amount of money, and I find that very appealing. The basic idea in using requirements is to not add a whole new layer of different sorts of requirements but to use the existing regulatory structure. That would include the areas of zoning and building codes. My own particular interest in EPA emission requirements and fuel offsets is another example. In terms of the incentives that I would recommend continuing to explore, the area of requirements and regulations is most promising. I was also very interested in the idea of various innovative financing schemes. I think this is another example of using the existing financial interest structure to accomplish our goal.

It sounds like we're a lot closer to the marketplace than we thought, that we've actually maybe gotten closer to having things accomplished in the private sector than we had anticipated. At that point, then, a lot of the incentives that we've talked about have maybe not worked the way we thought they would, but they have started getting us there. I think that it's very important that a lot of us have come out with a very conservative idea of how much should be spent on incentives. If we're really ready for the marketplace, it's when you get a call, or I get a call, that asks "Where can I go to get information?" you can just refer them to a company or a store, a retail outlet, or some wholesaler, or the utility company, that I think we've then really made some progress.

Robert Sears: My observation is that DOE has taken a lot of dollars. I think that they haven't done anything that badly; they've done some good work. Especially in the research and development incentive program.

One of the things that I think is really necessary is the broadening of the incentive base so we can bring in a larger market base for the purchase of solar goods. I believe that we are catering now to the top part of the economic group in our social structure. I think we need to broaden that by finding some marketing plan. In fact, I think that maybe DOE could spend some money on marketing plans and get this out to people who need it. Marketing plans aren't that bad because you at least get some ideas of what to do. I have to agree with Don, or whoever it was, who said we need to get along with moving this thing. We need to start putting it on the market so we can achieve more success than just development.

I have one other point; that is evaluation. I would have to agree with the need for evaluation. We need to determine where we are analytically and have some means of measurement of where we're going so that when we get to the year 2000, we will know whether we have arrived or not. I don't think there's a mechanism currently available that can tell us that. I think we ought to set up the mechanism now because we're already into it several years; and if we don't lay down some kind of a base, when we get there we'll have a pretty squeezey set of figures. Even

if DOE were to get into states and say well this is our data collection plan and we'll give you one-eighth of a person and funding to set it up, get it moving, keep it going, and keep the figures, I think that would be better than what they're doing now, or more than what's being done now. That would be one way to go.

I think that, observing human nature, when people are very enthusiastic about something and things don't seem to be going as well as they should, they begin to self-flagellate, and I think I've seen a lot of that here. I have to object very strongly to anybody who says that the federal government should get out of the business at this time; I think we're just getting the iron hot. If you want to forge something, you have to get it to the point where it's ready to work, and I think we're at the point now where we're beginning to see some results. We're beginning to see just inklings of the costs of these large programs. Now, the John F. Long Program was supported by DOE funding; we wouldn't have gotten where we are without DOE, I don't believe. The workshops were supported by SERI and by Western Solar Utilization Network; workshops on domestic hot-water systems are on solar systems for homes. All of these things are coming together now so that people are beginning to ask, "How can we get involved in this?" I think it is exactly the wrong time to start saying, "Let's pull out on all funding, maybe we're already there." We're not already there; we're just beginning. And, if we're going to realize 18 quads or whatever it is, we're going to have to get the iron a little hotter and start hitting it a little harder, instead of backing off. I think if we back off now, we're backing off before the race is begun, and I think it's just beginning to begin and has a long way to go.

Thomas Sparrow: Gradualism is what I think solar policy should be about. I think the worse thing we could do in the face of no more great triumphs of market penetration would be to turn to regulations and quotas as a means of speeding solar commercialization. It seems to me that we've got the incentives in place. We have already attempted to correct for the underpricing and overpricing by the existing subsidies. It seems to me that we should let the market function and not panic and not do anything we'd later regret.

Alfred Marcus: I think there is need for further research on incentives. Particularly I think that we now know something historically about incentives that have been applied. And, we know some things about the results that have been achieved. We still haven't had very much intensive description in terms of saying, "If we want to produce a certain goal, what actions do we use?" I think our knowledge is very inexact in this regard. There are a lot of interesting evaluations of programs in the incentives area. Programs that are now beginning should be evaluated in terms of trying to understand how to use the government power more effectively and more efficiently to achieve program goals.

Roland J. Cole: Hopefully, whatever turn our efforts take into the future, we'll be able to work with this group and expand on the more direct application and what we can contribute in the way of analysis and data and so forth to the efforts in energy policy.

Arthur Reiger: I would like to make two points. First, both Barbara and Jon raise the issue of where you focus. I've worked on residential solar energy for several years and it always seemed to me that there is too much federal effort on that. There's a tendency to emphasize the residential sector because of its large constituent base. It may be that the federal government's funds are perhaps misallocated in terms of where likely markets are going to take place--in the commercial area or industrial processes. I would say the same thing about energy conservation.

The second point relates to what Bob was saying about regulatory frameworks. We have some incentives in place that can be piggybacked with other Federal programs. If you take the framework of incentives and look not at the DOE programs, but rather at programs within HUD, EDA and USDA, you can imbed solar energy within these programs and then leverage incentives. These programs offer incentives in a whole variety of ways--whether it be loan guarantees, interest subsidies, longer maturities, etc. You leverage these incentives with a 15% investment tax credit and all of a sudden things fall in line nicely and solar looks attractive.

If you think about coupling the current solar incentives with existing Federal programs, I think you would find out that the solar budget in a few years will be higher than it is now without any new appropriations taking place, because they really wouldn't be "solar" programs.

I can see one great danger with the other Federal agencies and programs. As Jon says, we all take on some moral virtues because we say we're with solar. Various Federal operating programs are beginning to change their regulations and practices to incorporate solar technologies. I think we're into a real problem now because, in a way, this conference talks about very macro-level incentives; and if we can't deliver--we being the people who come out of the Research, Development and Demonstration programs, with semi-viable technologies, then those program openings don't do any good. And, in fact, they may get closed down because all of a sudden the operating programs are opening themselves up to solar and everyone says well, solar's a failure and we have nothing to provide.

May I take just a minute, Bruce, to describe on the blackboard how solar energy and existing incentives can be coupled with some operating programs. The Federal government insures and/or subsidizes about 200,000 - 300,000 multifamily housing units each year; mostly for low and moderate income families. There has been a number of recent changes in these programs designed to encourage the use of solar energy.

As of the fall of 1980, the mortgage insurance limits for these programs will be increased by up to 20% to account for the additional capital costs of solar energy systems. A developer can, therefore, get a 90% mortgage for a 40 year term. The developer's 10% cash-out-of-pocket is more than covered after the first year because of the 15% investment tax credit. In essence, there is no cash requirement for the solar energy system and the developer winds up with a 5% cash reserve.

Under the low-income Section 8 program, recently issued underwriting instructions allow up to a \$15 per month per unit increase in the rent estimate when there is a solar energy system. As a result, the carrying costs of the solar system can exceed the initial savings by as much as \$15 per month per unit. HUD has established this provision to encourage solar

energy systems with the expectation that over time the Federal government will have to provide a lower level of subsidies as conventional energy prices increase.

In any case, these housing programs are a one example of how existing solar incentives can be linked to other Federal programs. This perspective is often overlooked when solar incentives are viewed at the macro-level or apart from where the technologies can be applied.

Michael Shulman: The current solar program has a budget of over 800 million dollars, a considerable sum. A tremendous amount of money is allocated to different bureaucratic entities, including the national laboratories, SERI, and the RSICs. Existing political relationships and associated problems, taking place within the program have been counter-productive and have stymied coordinated and effective federal action to commercialize solar technologies. Speaking as an individual, rather than a member of the MITRE professional staff, I would like the people in this room to consider the radical restructuring of the existing institutional structure of the solar program. In its place, federal commercialization activity could be implemented by existing institutions, including the state energy extension services, land grant colleges, trade association, federal agencies and power administration, and state and local governments.

Congressional action has greatly expanded the solar program, but not provided clear guidance or realistic goals. Recently OTEC legislation calls for 10,000 megawatts of OTEC capacity in place by the year 2000. This is probably an impossible goal, under any scenario, but DOE must develop plans to meet this goal, rather than concentrate on short term problems facing OTEC development and commercialization. Congress has also required DOE to implement commercialization activities for solar technologies that are technically unproven.

Commercialization activity should be supplemented by cash subsidies and favorable regulations that also can be administered through existing institutions. Art Rieger's descriptions of existing pro-solar HUD regulations indicates that other institutions are willing and able to help

commercialize solar technologies. Tax credits may already be sufficient; other cash subsidies could be administered through SBA, state and federal government agencies, etc. These subsidies must be targeted at the grass roots efforts currently involved in solar commercialization; everything must be done to channel federal dollars to these grass roots efforts with speed and simplicity.

Congress, analysts and all other parties should view solar technologies as conservation devices and pass legislation that stimulates conservation, solar included. Solar technologies cannot, at this time, compete with conservation devices and practices due to technical problem, inadequate storage, and high system cost. Because of these limitations, solar should be considered only as a fuel saving technology, and Congressional initiatives should follow this line of development. The Department of Energy, acting in accordance to Congressional mandates and budgets, should develop comprehensive programs that place current solar applications in the basket of conservation activities and develop solar applications that supplement existing trends toward conservation.

When solar is to be considered a separate, distinct technology, it should be in the area of research and development. Lead centers should be designated for each major program area; several of these centers have already been selected, such as NASA Lewis for the wind program. This selection of a lead center is of critical importance to the solar thermal program, which is split among several centers, preventing coordinated and intelligent R&D activities. In addition to lead centers, the federal government should funnel R&D funds directly to private industry in a manner similar to research programs in West Germany and Japan. Solar technologies are not engineering puzzles; the problems facing these technologies can be resolved, for the most part, through product development.

I believe the past record of the solar program justifies a complete shakeup of the organizations involved in the solar program; the program is, at present, expensive and responsible for many technologies that cannot be successful in the near future. DOE headquarters passes through money to the labs and RSECs, each of which has a political constituency

and a different emphasis on technology development and commercialization. Money pours into DOE, yet grass roots efforts go unrewarded while large, expensive applications dominate the budget. Barstow is still incomplete, OTEC-1 is overrun, only three percent of the funds for the FPUP program have been appropriated and spent, and people at the local level seem unable to get support from DOE, SERI, and the RSECs or the labs.

Whenever a program is criticized, a reorganization is proposed, people are shuffled around, new power centers arise, and the budget increases. This is not what I recommend; it should be avoided at all costs. If the program is radically restructured, its focus should be on displacing foreign oil and used to supplement existing programs and conservation activities. New people with fresh ideas and a new approach should run a new program. The current players have been involved with their programs for many years and may not be able to overcome current problems with old constituencies and old ideas.

One last comment; the public, industry and bureaucrats should be made to know the federal government is not pro-solar because it is nice, or makes people free from utilities, or is part of Amory Lavins "generator in every home" heaven on earth. The general public has been misled about the status, cost, and potential of solar energy. The federal government must develop a credible solar program by making it part of a comprehensive national energy policy which in turn is part of a national reindustrialization or revitalization policy. Solar program must be made to serve national goals, and the technology must be treated as one of many alternatives, and not as a panacea to our energy problems or an answer to big business domination of energy markets.

Thank you for your time and patience. If my recommendations are strong, and seemingly based on cynicism, it is because I am one of the pro-solar people who have been disillusioned by three years of work in the solar program. I do believe the creativity, intelligence, and experience of the people in this room represents the potential for a new solar program, one that is realistic and effective.

William Babcock: I think that a number of good points have already been made and I will just reiterate them. Of particular concern to me is the development of a clearer and hopefully more realistic picture of exactly what benefits solar energy can bring to the individual consumer and to the nation as a whole. Without this clear cut specification, it is impossible to structure a coherent solar policy in general and a solar incentives policy in particular.

From a Federal government standpoint it is necessary to come to closure on our national commitment to solar energy. Is the President's 20 percent energy supply goal for solar by the year 2000 realistic? What particular benefits does solar energy have that other energy supply options do not have?

Even if there is movement to oppressively support the 20 percent goal, will consumers support solar? To date the answer appears to be negative. Consumers have not responded dramatically to Federal programs and financial incentives. There are less than 500,000 solar installations in the country today, well behind the number required to be on track to meet the 20 percent goal.

As policymakers involved with solar energy development, we must step back and ask ourselves some basic questions. Of paramount concern is the question, "Is solar an economically viable alternative to conventional energy sources, as well as other advanced technologies for the nation?" Solar must not be supported merely for the sake of solar, but rather the use of solar energy must lead to a more efficient use of a nation's resources through time. We do not want to end up subsidizing a solar technology that is always priced 25 percent above the competition; as a nation we cannot afford this. Our inability to afford this type of behavior is represented by the recent emphasis being placed upon reindustrialization and increasing the efficiency of American industry. We have isolated a number of segments of our industry from competitive forces and as a result they have gotten soft, we cannot support energy policies with similar end results.

As was stated earlier today, a 40 percent tax credit for solar is significant, in some states it is even larger. If this magnitude of

subsidy does not get a market response, then we must recognize that the market is trying to tell us something. Solar energy isn't here yet.

As policymakers, we must acknowledge these market forces and design appropriate policies. For instance, basic economic and marketing theory would have predicted the current market response to solar tax credits. Innovators, whose decision criteria are non-financial, are receiving "windfall gains", since they are receiving financial subsidies to make purchases that they would have anyway. Firms are not investing in large scale plant and equipment, since there is still great uncertainty regarding the viability of a solar market without tax credits (tax credits are scheduled to be phased out in 1985). Hence, looking back on the use of tax credits as a policy instrument, we are likely to find that rapidly throwing money at a new technology will not counter basic market forces.

There is still a great need for solar policy analysis activities. We must reassess the basis for Federal support of solar energy and develop realistic goals. We must determine the most effective Federal role and show greater selectivity in recommending and using alternative policies. To date, solar policy has been based on a shotgun approach and we have begun to enter a period where policies will require greater focus and precision.

Gerald Bennington: I've noticed a shift in attitude that might be characterized in part by the election blues. The other part I would term solar adolescence; they've stopped patting the solar program on the head and telling it how cute it looks. Now it's getting tall and gangly, and has a bad case of the zits, and is very impatient with its heritage. That is manifested a little bit by some of the comments that we've kicked around here that DOE and the federal government can't or maybe won't be allowed to manage a broad program. I'd like to thank Art, in particular, for coming because he has both longevity and some accomplishments to describe. This is a very unfamiliar thing to find in the solar program.

But against this feeling of frustration, possibly with the federal government, is some recognition at the grassroots level--the example from Arizona was an excellent one--that there's a lot of people who are doing

some very good things. Around my neighborhood I see a lot more solar systems than I saw when I moved in seven years ago. I had the first solar system in the neighborhood and now there are a "whole bunch".

The discussion we have had is manifested in a more limited and conservative approach than I've seen in the past. We should limit government involvement to things they can do well like taxes, raise an army, and give money. There should be a heavy emphasis on market choice and profit motivation and we should forget the gimmicks. Let the system do it as it has in the past. It works. After all of this study we really know who the winners are; and as Roger challenged us before, there are no new incentives to discuss. We've discussed them all several times and the time we analyzed them is well past. If you take all those things, this might be combined in a budget. Lumping together taxation and marketing activity, tax incentives and loans, and things like that, these incentives probably should get about 75% of the money you want to spend. That's just a market pull to help establish a market and let it do it's own thing from there. Under what is classed here as nontraditional activities, which is the big "R" and maybe a little 'd' and no demonstration, it might be 25%. There are some excellent research and development programs in existence. I would think that the research part of the photovoltaic program is probably the best way to handle it.

If you take those things and you spread them over time, you find out that you have a fairly level budget. Research and development ending at about 1990; the incentives you have now, continuing through '90; and then if the world turns out like some people would like, the bulk of the incentive money, about 60% of it, being spent in the last decade. You can fill out the other end.

We've seen some opportunities, and we've provided some incentives for solar--they're real, they're available, and they give solar a significant edge, and I think that's great. The opportunity, if it's not seized, may go away. That's true in a lot of other things.

There's an opportunity for solar to make a profit for the solar industry. And we are at a watershed with regard to some areas of opportunity, and it's not DOE that's going to make or break it--it's the

people that have been struggling along to get an opportunity. I think that there are lots of little things you can do to help them. I think it's important to see how this turns out; but there's very little that most of us are going to do about it from here on.

Raymond G. Anderson: Going back a little bit to what we said before in creating a need, maybe we ought to do rather than talk about solar incentives. How do we get all the TV's, radios, and stereos to return to DC so they would have to return to wind?

I really feel that solar needs to be visible to the consumer so that he can make the decision to purchase, to install, and to utilize. My feeling right now is that the consumer is receiving a lot of mixed signals. There are a lot of people running around waving the flag. You've got to go solar, but the people running around waving the flag are not going solar. My suggestion is that the federal government should solarize its own buildings in the community, and instrument the installation so that the consumer can see how much energy has been collected from the solar system. To me, it's a lot more valuable if I can walk down a few blocks and see a solar system operating and see what it has collected than it is to go through a computer printout to find out what the projection is to my particular area. This will help build the marketing system and will give the consumer actual information that can be used to purchase. This will also give the consumer the message that the government is serious about the solar commitment. What's good for the goose is good for the gander.

Tax credits should remain in effect to bring solar into parity with other forms of energy. The government also needs to finance research and development to improve efficiencies and to reduce the impact on our national resources and reduce the amount of energy to produce the solar equipment. The government should undertake a program immediately to begin solarizing its own buildings. The program should be phased over a ten-year period. The incentive cost of that program would be based on the incremental additional cost of instrumentation, not necessarily on the total cost of the program. Looking at your Table 2, where you have

various incentive types and suggested dollar values, billions of dollars just don't click in my head. I'm not attuned to that kind of money. I think that it looks very well thought out, it's based on history. The only thing that I can really say anything about it is that the requirements would start reducing rather than continuing to increase. If we continue to build up the requirements and add more standards, regulations, etc., the solar will never do anything. We have to keep it simple.

Jeff Hammarlund: I entered the field of energy policy with a background in political science and international relations. It may not seem surprising, therefore, for me to agree with Roger that we must not lose sight of the important foreign policy and international security implications of our energy policy. We need to place a high value on resiliency as we design our national energy policy. Resiliency implies a diverse, multi-technology, multi-fuel, multi-path supply strategy. It implies a certain amount of redundancy in the system so the Nation does not become over-dependent on any one supply alternative. And it implies an emphasis on energy efficiency, whereby we encourage the use of our scarce energy supplies in as efficient a manner as possible.

We have discussed the notions of economic efficiency and the market as the best guides to a viable energy future. It has been argued that the market is the best determinant not only of our Nation's level of energy demand, but of the Nation's choice of energy supply options and pace of development.

Certainly, the market is a very powerful and valuable tool. It is undoubtedly more "intelligent" than any cadre of bureaucrats, planners, or consultants. Market signals would be much more useful, however, if the energy market were not so biased, both by price controls and by large supply subsidies, many of which have been identified in earlier studies by this Battelle team.

My point is that while market signals should be a major determinant of our future energy policy, they should not be the only determinant, as a few here seem to suggest. I surely do not need to remind anyone here that

many Western nations shifted most of their supply mix to oil, foreign oil in most cases, because it was the most "rational" strategy from a strictly economic standpoint. The resulting loss of resiliency and redundancy in these nations' energy supply structures has been effectively exploited repeatedly, beginning with the Arab oil embargo of October, 1973.

National security concerns have led Al Alm, DOE's former Policy and Evaluation director, and others to recommend the use of an "oil premium" on imported oil as an analytical tool to be used in comparing and selecting energy programs. The premium price would represent the value that society places on reducing oil imports to enhance national security. It would be a price somewhere above the market price, which incorporates the external costs to our national security of importing oil. As a policy tool, the premium price would be used as a yardstick against which to measure current and proposed energy programs. Any government program aimed at reducing imports would have to show a lower cost-per-barrel than the world market price of oil plus the premium.

Another useful analytic tool to supplement the market as a method of cross technology comparison is the "least cost energy strategy" developed by the Mellon Institute and others. Briefly, this is a methodology to identify society's end use needs -- transportation, heated buildings and the like -- and then to identify the mix of technologies which meets those needs at a minimum cost. An important aspect of the analysis is the inclusion of hidden costs, such as environmental impacts in the overall cost of the technology. The analysis helps to reveal the least-cost strategies in social, as well as economic terms.

The day before yesterday, I talked about the Department's efforts to restructure its State and local programs via EMPA. It will be important to provide these units of government with the start-up money and the technical assistance that they need to respond quickly and effectively to the market price signals. Decontrol will certainly provide the proper price signals. EMPA is designed to help give state and local governments the capacity to respond to them.

Finally, I want to comment on the statement made that none of the federal solar programs are working. Our report card to date is, of course, mixed. Some of the most promising programs in support of commercialization -- such as the 40 percent solar tax credit and the Solar and Conservation Bank, have only recently been established by Congress, and it is hardly fair to already call them failures. If the solar programs do not work out, let's make liberal use of the Sunset provisions; but first let us give them a chance.

Roger Bezdek: There are three or four points that I would like to make as quickly as possible. First of all, since the inception of the solar program, the solar industrial process heat program has been grossly and seriously underestimated and underfunded. No matter what the level of the solar program, be it a million dollars a year or a billion dollars a year, it should be recognized that process heat is one of the big winners if not the big winner of any time in the intermediate- to near-term future. As a rough estimate, process heat should get anywhere from one-fourth to one-third of the funds. This goes for policies and incentives as well. Second, I think it is important to recognize that the major problem that we face in this nation in terms of energy policy is a liquid fuel crisis. We are overly dependent upon imported petroleum, petroleum imported from a small group of nations that are politically, to say the least, unstable. In terms of solving this near-term problem of over-dependence on imported petroleum from a small group of nations who may for political reasons act in concert to embargo these fuels, solar (and by near-term, I'm talking about the next five to ten years) is irrelevant. It's not the solution to the near-term problem. I think the consensus here is that there is no way it can be. This does not mean that it's unimportant in the long run or in terms of reducing the rate of increase of fossil fuel prices and so forth. It's obvious, but it's not widely recognized and if I see one more statement by some solar freak that solar is the way to progress from blackmail by OPEC, I'll either puke or kill him. Drastic as they may be, perhaps the best thing we could do is stop spending money on solar programs for the next ten years and use it to fill the Strategic Petroleum Reserve.

The Battelle work that's been going on now for three years has worked the topic of incentives for solar energy to death--which is fine--that's what they were intended to do. What I'd like to see, if anybody picks up this work in the future, is to expand the analysis to a U.S. energy policy in general. Not only solar and conservation, but if you look at oil and natural gas and conventional sources of fossil fuels, synfuels, oil shale, pipe gas, deep gas, what have you, and try to put it into a context of energy policy in general, which I think we have gone a ways toward doing. But by necessity, the focus has been on solar in the past several years. It's time to broaden it.

As to the proper use of the Battelle work, as I've tried to emphasize over the years, that just because these energy sources over the past and to various devices have got "X" million dollars in incentives and so forth, does not justify any sort of incentive policy program for solar or any other energy source in the future. It does provide a valuable input, but I think there is a real danger that all the analyses that have been conducted in recent years will be misused or abused.

In the context of U.S. energy policy, short term, intermediate term and long term, I realize that it's not a question we can answer today, but it's worth raising. Second of all, perhaps more importantly, an awful lot of people spend an awful lot of time and a lot of money has been invested in this work and related work over the past three or four years. And, it's one thing to come to these conferences and have many of the same faces sitting across the table, conference after conference, year after year, but given all these wonderful things we've done--analyses produced, papers written, monographs produced, and analyses completed--how do we go about insuring that all this work has any direct impact upon actual policy formulation? Maybe there's more PR work required than more analyses, I don't know. Maybe it's more sitting down with legislators in Washington or on the state level or what have you. The comments that have been made here about the level of ignorance which exists in many other sectors--certainly, much of what we've discerned, analyzed, computed or estimated needs to be much more widely disseminated. We take either an active or a passive approach--passive being that we've got the papers

written, the journal articles will be appearing, and the monographs produced--let it gradually diffuse into society and maybe in 10 or 15 years people will recognize it has been done. The second sort of thing is to pull an Amory Lovins type of trick where you become a total radical nut and oversell your policies to get the message out to some of the people in whatever form. I think there's a lot to be said for the latter.

There's another important example that I'll just take a second for and that is in the Conservation Bank the only way that someone can get one of those loans is to purchase equipment that has a one-year guarantee, one-year warranty. Now, if Providence is not willing or able to provide a product with a one-year warranty that they can stand behind, those funds won't go out.

As closing remarks, I think I'd just like to call on something which has come into perspective very recently, that is the whole idea of this reindustrialization policy. I want to pick up where I think Bill left off just a short while ago. It was earlier mentioned that perhaps what we want to do is to make solar an integral part of this reindustrialization campaign. Maybe, but on the other hand, maybe not. Having spent a good portion of my time this summer working on what has now come to be called "the reindustrialization of America" or "new industrial policy" or what have you, the whole idea of it is a perception that American industry--certain manufacturing sectors of the economy--for one reason or another have become noncompetitive in the international market. Now how do we, we being the government or the nation, change this, turn this around in a number of years so we compete with the Japanese, the Germans, the Taiwanese, and what have you? The whole idea is to make American industry more productive. My point is that solar is not all that efficient an energy source as of today and it may never be--certainly not in terms of cost or reliability. If you have on the one hand, a goal of making industry more efficient and you tack on to this what is making it the least efficient, most expensive source of energy and you want to combine them, God help us if we're going to try to compete with Toyota in 1981 automobiles. Solar may be a very valuable goal and the reindustrialization policy may be a very valuable goal, but to assume that

they're one and the same thing is a grave mistake. And to conclude, the pie is only so large. We want to have clean water, clean air, energy independence; we want to have solar energy; we want to have a reindustrialization policy, strong national defense, etc. There are some hard choices that will have to be made, and I think in 1980 the choices are going to be more more difficult than they have been, certainly because of the Great Depression, because things have changed and the pie has stopped expanding at the rate it has been, certainly since World War II. The recent problems we've seen with financing for solar are and the difference between incentives and so are indicative of this. You know, the policy questions over the next decade are, I think, very painful.

Richard Chew: I just want to concentrate on a couple of things that sort of hit me personally, perhaps because I came in here far behind most of you. First of all, I'm very pleased to see that the 20% goal is being looked at much more realistically. I don't think that really means that we have to have a PR campaign to destroy it. That's very much like saying we are going to beat the other team 75 to nothing. Then everybody goes out onto the field feeling great as long as we don't try to make a touchdown when a field goal would do very nicely. I have been struck primarily by the line between the studies that we've done that had to deal with production and generation as opposed to the kinds of incentives for solar, which will have much more to do with hardware. One of the things that came out of this is that it led to a closer lock up between the user and the provider. What I did hear on that was that the incentives for residential consumers come out to be one kind of thing. We hear from commercial users that incentives will have to be something else. Generally, a person with a building is only interested in numbers; he's not interested in whether his neighbor's smoking that particular brand of cigarettes. Therefore, that in my mind, plus the very interesting numbers that come out for government as a direct user of solar power, I am led to think that the big buy is a very important next step, an early step, both because it is exemplar to at least a commercial user, if not the residential user, and also because there is so much of it. There are some other little values in this. I have a hunch that a great deal of it could just

be accomplished by executive order, and that is not an insignificant factor in deciding in whether to do something. Another thing, a side benefit is that a government big buy very often leads to some standardization that you could kill yourself trying to achieve by regulation. You go into the gas station now and you buy that can of ATF or whatever it is, and it says meets the standard of DOE standard of so and so. There's a lot to that. Finally, I'd just like to say that--with respect to the early windmills which seem to be coming back for more and more comment--as an Eastern liberal, I think there is room for dc as well as ac.

Lee Johnson: Most of you know I'm a new face here this morning. I'm Lee Johnson, I work at the regional office of the Department of Energy here in town. I made myself an introduction because No. 1, I'm stuck in being the practitioner for those things you are all talking about. No. 2, in respect, I'd like to respond to what I've been hearing from all of you. I'm surprised, that I haven't heard mentioned the incredible shift, base shift in the last couple of years caused by the Iranian revolution in solar and conservation incentives. I sat downtown in the Federal Building in Seattle for five years pushing conservation; it was kind of like pushing a string. It just buckles up in your hand. Shortly after the Iranian revolution and the change in basic oil prices and the consequent push to other traditional energy kinds of work, I had footprints all over my back from people rushing into conservation. I'm finding, sitting on the 19th floor of the Federal Building today, I've footprints all over my back from people rushing into solar. I just had lunch yesterday with some utility folks out here, Puget Power--which is a local utility; they're in a terrible trouble. Any kind of a hard winter and they're not going to be able to meet their peaks. The utility folks were pussy-mouthed awful hard to say you've got to get out there and give these people some money so we can get those solar installations so we can keep these three businesses in the area and we trust alive. The game has changed incredibly and I guess what I haven't heard from you folks is what I see, as our biggest chore--to get government the hell out of the way from what's going on. Now that means, a crying need right here, today, to get solar heaters on the Bellevue swimming pool and the Bellevue Building Department to call us

up to see how to do those things. They don't know how they need help. I don't have anything; I don't have that much capability to give them help. The game has all changed. I don't have to talk to Weyerhaeuser about putting in hog fuel boilers; they're so far ahead of us that it's just incredible. I'm afraid that we're caught with an archaic system in the federal government; it's going to take too much time to get rid of this archaic system. So all these incentives we were talking about, that I've heard you all talking about, I think they're old-fashioned already. I'm quite impressed by everything else I've heard here. We have a terrible problem when Bonneville Power Administration becomes the biggest source of power in the conservation game. How will they do it properly? So, it's a very real situation, of course, what you're talking about is going to be very real in the next several years here.

Alan Miller: One of the things I have worked on this last year is the point that Arthur made concerning the value of working through existing agencies, and I agree with it strongly. In particular, what I've been trying to think about is what DOE should do. I think part of what the significance of what Arthur said is that DOE can't possibly do as well as agencies that have been around much longer and have a much better understanding of energy sectors of the economy. The problem of agencies; new agencies like DOE and EPA that are set up to deal with issues that are so cross-cutting, is that it requires that they attempt to understand the entire economy in ways that they can't possibly do. They can't possibly know as much about the housing market as people at HUD know. They can't possibly know as much about agriculture as the people in the Department of Agriculture know. And part of the reason that advocates, like myself, get drawn to DOE is because we don't have the political clout at those other political agencies; and so we think we can pull an end run and go to DOE. What we have to realize is that it's time to push a little harder on those agencies as difficult as they are. I can't say that I'm one of HUD's greatest fans, with the exception of Arthur's program, of course. In the same context, and to the extent, that we can recognize emerging new policies in which solar can have an impact, we should very much turn our attention in that direction. It is clear to me, for example, that while

it is always difficult to predict new policy issues in advance, I believe that industrial redevelopment in this country will be one of the major issues of the '80s. When we start seeing themes on three or four major magazines at the same time, and people making political speeches about it, it will be one of the issues whose time has come. When more large industrials go bankrupt, it will receive an even greater impetus. I think solar can have a very natural place as a potential new high-technology industry for the skills that American industry has to offer. I also strongly support what Barbara has said concerning high-leverage opportunities in existing regulatory programs. I think there are more of those high-leverage opportunities than perhaps we discussed at this session. We see the government procurement, existing building and subdivision regulations, and existing utility regulation as examples. I think there are more; for example, Lee Schipper has done some work on revisions to licensing for professions, and the possibilities for adapting licensing requirements for architects and builders, etc., to assure that they have within their training and within their formative years a sense of what solar energy is all about.

Part of what I've gotten out of this session is a real sense of how little we really know and how difficult it is--even after a million dollars and several years of attempting to use the state of the art in evaluating incentives--how little we do know about what works and what doesn't work. I think this exercise has been very valuable in demonstrating that to us; it's a humbling experience. To recount the implications of that are things that people have said and that I can only second. A variety of strategies should be pursued which protect us from putting all our eggs in one basket. We should recognize the ingenuity and creativity of people on the state and local level. The Arizona example was a good one. We should also recognize that money may not always be the most effective and the only way of approaching incentives. Finally, we should look for a new way, even if it means going to different cultures, different countries where things don't immediately sound very relevant; we need all the ideas we can get. I think we're running out and it's time to try new things and intentionally experiment and accept the fact that we may not always know how successful things will be in advance.

Well, we all agree on the importance of the market and the strength of market mechanisms. I would like to say that we all also know that there are a lot of market imperfections even in industry, even among industries and the utility sector where we like to emphasize the "power of a buck" to motivate behavior. The imperfections in the market forces are tremendous. I do as many visits to industry conferences as I do to these policy analysis conferences, and the level of ignorance and the level of noneconomic incentives that motivate those people is always surprising me. The literature that I've been trained in always assumes that if you just put the market forces there, they will respond quickly. I'm sure they respond over time, but I think the whole reason for this conference is that we view timing as important. So, if timing is important, you're apt to say, Well what incentives do you use to move things a little quicker? And, we've got to go through the whole thing all over again.

Finally, I agree with Richard; we all know, as policy analysts, that a 20% goal may be pretty ridiculous. Goals have a lot of political value, but why should the level of energy political rhetoric be any higher than the level of political rhetoric in any other area? That 20% message coming from the President is a form of exhortation and forms an incentive in and of itself that I don't think is all that undesirable, all that misleading, or all that dangerous. It doesn't particularly bother me. This country has a commitment to intervene in energy policy. The government is going to intervene in energy policy and whether it's Carter setting the 20% goal or Reagan talking about incentives for nuclear energy, we're going to have incentives, and we're going to have government intercession in energy policy. And my personal political sense is that the type of incentives and the type of commitment solar energy is likely to have will be far less disruptive on the economy and have far less disruptive impact on the quality of life and the quality of society. I'm not advocating a policy of parity. I don't license that concept of parity and I think we all reject it as an analytical framework in formulating an energy strategy. But as a criteria to be applied in assessing incentives for solar energy, I think we can't ignore it. We can't simply say in an ideal world that we would adopt these incentives for solar energy while neglecting the criteria being applied to other energy alternatives.

Bruce W. Cone: Two years ago I was humbly awed by the last hours we spent in this conference. And I am once again humbly awed by the power of thought that was developed during the sixty hours that we have been together.

As a farmer, I can tell you for certain that there is time to plant and a time to harvest. I think one of the conclusions I draw, both from the workshop in general and from the remarks this morning is that the grain is golden. The ideas and the analysis are ready for harvest. The farmer cannot dictate whether the grain is eaten, discarded, or burned as fuel. Our job is to wrap this work up and to get that information out to those who wish to carry it on. That is my intention. We will try to bring all the work together in a single readable volume. If analysis we have discussed over the past ten hours is used, it'll be our pride and also your contribution. If it's not, that really isn't our decision. I want to thank each and every one of you for coming. You were each invited for a very special reason. Collectively, you have allowed the Battelle Incentives team to participate in a very special interaction. Thank you, and have a safe journey.

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