An Executive Summary**An Analysis of Federal Incentives Used
to Stimulate Energy Consumption****April 1981**

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AN ANALYSIS OF FEDERAL INCENTIVES
USED TO STIMULATE ENERGY CONSUMPTION

An Executive Summary

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CONCLUSIONS WITH RESPECT TO SOLAR ENERGY POLICY

An Executive Summary

The purpose of the analysis presented in this report is to identify and quantify federal incentives that have increased the consumption of coal, oil, natural gas, and electricity. An analysis of public incentives can form the basis of initial insights into the kind, quantity, and duration of incentives to stimulate the use of renewable energy resources. This summary is intended as a device for presenting the policy questions about the incentives that can be used to stimulate desired levels of energy development. Decisions about incentives involve not only dollars, but also types of incentives, particular technologies, intended user groups and the timing of incentives.

The estimates of past incentives presented can be useful in framing new incentive programs in three ways. First, the rationales used to justify historical programs may be useful in arguing for new programs. Rationales of aid to infant industries, moving an industry along a learning curve more rapidly, and aiding particular social or geographical groups may be applicable to solar industries. Second, the mechanisms used to provide incentives in the past are basically tools that are available at present. Our research is one of the few attempts to develop a theory of how the government can give incentives, and to provide data on the efficacy of using various theoretically available "tools." Third, the data on historical use of various incentive types provides indicators of preference for one type versus another. These data can be guides to policy makers as they consider how to implement new incentive programs.

The conclusions about past incentives can be a guide in choosing the particular incentives that deserve careful consideration in the years ahead. It is intended as a point of departure in the process of achieving a national goal through the interaction of scientific inquiry and public debate. If it is socially desirable and technologically feasible to increase solar energy's share in the national energy budget, the paramount

policy question is one of selecting an incentive strategy and determining the government's level of investment in it.

Federal incentives for the consumption of energy are Federal Government actions whose major intent or major result is to stimulate energy consumption. The stimulus comes through changing values of variables included in energy demand functions, thereby inducing energy consumers to move along the function in the direction of greater quantity of energy demanded, or through inducing a shift of the function to a position where more energy will be demanded at a given price. The demand variables fall into one of six categories: (1) price of the energy form, (2) price of complements, (3) price of substitutes, (4) preferences, (5) income, and (6) technology.

The government can provide such incentives using six different policy instruments defined in the introductory chapter: (1) taxation, (2) disbursements, (3) requirements, (4) nontraditional services, (5) traditional services, and (6) market activity. We examined four energy forms: (1) coal, (2) oil, (3) natural gas, and (4) electricity. And we examined six energy-consuming sectors: (1) residential, (2) commercial, (3) industrial, (4) agricultural, (5) transportation, and (6) public.

When all energy incentive actions taken during fiscal year 1978 were analyzed it was found that the overwhelming proportion of these incentives are classified as "incentives with non-energy related intent." Funds used to construct highways, operate government buildings, and transport government personnel have major influences on national energy consumption patterns. The Federal Government is the single largest energy consumer in the economy. However, the primary intent of these programs has little to do with shaping energy consumption patterns. Total non-energy intent incentives amounted to \$28.8 billion in 1978. About 47% of these funds consisted of market activity to operate government buildings and to transport government personnel. Disbursements accounted for nearly 44% of these funds, and traditional and nontraditional accounted for over 9%. Incentives with energy related purposes amounted to \$2.3 billion in 1978. Nearly 91% of these incentives were for oil consumption, with solar and

other nontraditional energy forms receiving 8%, and the remaining traditional energy forms (coal, gas, and electricity) each receiving less than 1% each. Almost half (42.1%) of the incentives with energy related intents were in the form of tax exemptions, and more than a third (38.5%) took the form of market activity incentives. The remainder of the incentives are divided among disbursements (12.2%), requirements (5.0%), and traditional and nontraditional services (2.2% together). Thus, the 1978 spending patterns suggest a concentration of incentives with energy intent in taxation and market activity. The incentives with non-energy intent were concentrated in disbursements and market activity for the most part, and required almost fifteen times as much funding as the incentives with energy related intent. Since several purposes, both explicit and implicit, are served by these actions, it is not surprising to find higher spending levels.

Our analysis shows that the Federal Government has expended \$170.4 billion for incentives to stimulate energy use. This figure, and all of the estimates below are the undiscounted sum of spending in relevant categories over the period 1950-1978 (unless some other period is specified), reported in constant 1978 dollars. (No discounting of incentives was done on the grounds that many incentives have cumulative effects over long time periods; they are public sector "investments" whose effects are felt over long periods of time in both the private and public sectors.) These expenditures are presented in Tables 1 and 2 according to energy form, incentive type, and user sector.

Energy Forms

As shown in Table 1, oil consumption received the largest share of incentive funds (75%), more than twice the share of any other energy form. The second largest share of federal incentives (23%) went to the promotion of electricity consumption. Coal received about 2% of the consumption incentive dollars, while natural gas received only 0.1%.

TABLE 1. An Estimate of the Cost of Incentives Used to Stimulate Energy Consumption,
by Incentive Type and Energy Source (Millions of 1978 Dollars)

	Coal	Oil	Gas	Electricity	Total	Percentage of Total Incentives
Taxation		28,086			28,086	16.4
Disbursements		3,466	201	6,959	10,626	6.2
Requirements	10	80,414			80,424	47.2
Traditional Services		15,825 ^(a)			15,825	9.3
Nontraditional Services	3030	75		242	3,347	2.0
Market Activity				32,113	32,113	18.8
Totals	3,040	127,866	201	39,314	170,421	100.0
Percentage of Total Incentives	1.8	75.0	0.1	23.1	100.0	

(a) Negative value of highway trust fund omitted (\$60.6 billion).

TABLE 2. An Estimate of the Cost of Incentives Used to Stimulate Energy Consumption,
by Incentive Type and Sector (Millions of 1978 Dollars)

	Residential	Commercial	Industrial	Transportation	Agricultural	Public	Total	Percentage of Total Incentives
Taxation				24,130		3,956	28,086	16.4
Disbursements	415			10,211			10,626	6.2
Requirements	12,749	(a)	30,634 ^(b)	34,655		2,386	80,424	47.2
Traditional Services				15,825 ^(c)			15,825	9.3
Nontraditional Services			3,105	242			3,347	2.0
Market Activity	37	16	11,949			20,111	32,113	18.8
Totals	13,201	16	45,688	85,063		26,453	170,421	100.0
Percentage of Total Incentives	7.7	0.0	26.8	49.9		15.5	100.0	

(a) Requirement incentives for Commercial oil consumption included in Residential.

(b) Includes electric utilities and non-transportation agriculture incentives for oil consumption.

(c) Negative value of highway trust fund omitted (\$60.6 billion).

Incentive Types

As shown in the rows of Table 1, the largest proportion of incentives were in the form of requirements (47.2%). Market activity was the second most common incentive type (18.8%), with taxation a close third (16.4%). Traditional services (9.3%) and disbursements (6.2%) were roughly comparable in magnitude; nontraditional services accounted for just 2% of incentive costs. Note that in the cumulative estimates, incentives with energy intents are mixed with those with other intents, whereas these two types of energy incentives have been analyzed separately in the analysis of incentives in 1978.

Comparing these cumulative incentive figures to the single year estimates, the relative roles of taxation, requirements, and disbursements appear to differ greatly. Taxation received greater emphasis in 1978 than in the average over all previous years. Requirements are larger in the cumulative estimates. Disbursements play a larger role in the 1978 estimates, but are found mostly in the category of incentives with non-energy intent.

User Sectors

Looking at the sectors (see Table 2), it is clear that transportation got the largest part, nearly 50% of all incentives. Large items are crude oil price controls, and aviation subsidies. (This estimate excludes federal highway programs, which have helped increase the use of motor fuel, but have collected more in highway user taxes than have been spent.) Industry has gotten the next largest allocation (26.8%), primarily from crude oil price controls and sales of government produced electricity at low prices. Government use of government produced electricity is another large item, which contributes to the public sector estimate of 15.5% of total incentives. The residential sector received just 7.7% of the incentive funds. The low estimate of incentives for the commercial and agricultural sectors is partly a data problem. Commercial use of oil could not be separated from residential oil use, and non-transportation agricultural oil use could not be separated from industrial oil use. The transportation estimate is complicated by the fact that some of it is really commercial, industrial, agricultural, and

personal consumption activity. Only government transportation could be disaggregated from the totals.

Demand Determinants

Examples of the use of all of the demand determinants identified in traditional economic analysis. The largest determinant of demand has been price, principally through requirements (price controls for crude oil) and market activity (sales of electricity from federal projects). Technology determinants are next, the largest item being improvements in airports and aviation facilities. Income determinants, in the form of disbursements, and changes in the price of complements have had a minor role. Preference determinants of demand have had a small budgetary cost but involve federal programs with legal requirements, such as enforced switching to coal. The cost to a violator could be very high.

AN APPROACH TO SOLAR INCENTIVES

The analysis of historical use of incentives for traditional energy forms suggests a number of guidelines for solar policy. We do not expect history to repeat itself precisely, but neither do we expect historical patterns to be suddenly and widely disrupted. Thus, our examination of historical incentives used to stimulate the consumption of coal, oil, natural gas, and electricity suggests some guidelines and limits for the use of incentives to stimulate consumption of solar energy.

Several conclusions for solar policy are clearly related to the data we have assembled. That is, we suggest that direct analogues to historical policies may exist in some cases. Many of the programs which stimulated use of traditional energy forms were not directly energy programs, but had other purposes. As side effects, or second-order impacts, such programs as highway construction, port construction, and government use of energy have had powerful influences on national energy consumption patterns. A solar policy analogue is encouragement of solar power as an energy source in re-industrialization programs.

A major conclusion from this volume is that substantial incentives have been given to stimulate consumption of energy, \$170 billion.

Previous research has established that production incentives were also provided, amounting to \$252 billion over the same period.⁽¹⁾ The historical incentive patterns suggest that it is not necessary to choose between supply-push and demand-pull strategies for stimulating new industries. The historical pattern in the energy sectors is to stimulate both sides of the market. In addition, the incidence of the incentive frequently is shifted from one sector to the other, making the distinction somewhat blurred.

Another important type of traditional action which government could consciously use to stimulate solar consumption is to specify solar space conditioning and electric power systems in selected government facilities. Such solar systems are cost competitive in a few installations at present. Furthermore, a dramatic decrease in cost as production increases (learning-curve phenomena) for some solar technologies (photovoltaics) could allow early Federal Government purchases in significant volumes, even at higher than competitive prices, to bring down costs in the future to the point that very widespread market penetrations will be possible. The Federal Government, as the single largest energy consumer in the economy, and as a major energy producer and major element of capital markets, can be very influential in shaping the future of solar energy through selective use of market activities.

More general guidelines for solar incentives also stem from this research. Traditional energy sources have been significantly stimulated by a variety of types of incentives given to both producers, as demonstrated in previous research,⁽²⁾ and to consumers, as demonstrated by the estimates in this study. In order to compete well, solar energy will require similar governmental stimulation to overcome the cumulative effects of past stimulation of other energy forms and to offset on-going stimulation of other energy forms. The amount of spending on traditional energy forms, over \$170 billion in consumption incentives and \$252 in production incentives, may provide a rough guide to the magnitude of spending on solar incentives that will be required to achieve particular solar production targets.

NOTES - CHAPTER VIII

1. B. W. Cone et al., An Analysis of Federal Incentives Used to Stimulate Energy Production. Report for the U.S. Department of Energy by Pacific Northwest Laboratory (PNL-2410 REV. II), February, 1980.
2. B. W. Cone et al., February, 1980.

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