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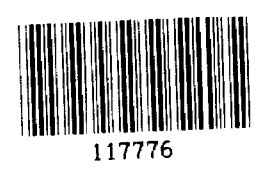
REPORT BY THE U.S.

# General Accounting Office

## Studies On Effectiveness Of Energy Tax Incentives Are Inconclusive

The Congress has enacted a series of tax incentives to encourage energy conservation and spur production of alternative fuels. GAO was asked to report on what is known about their effectiveness.

GAO concludes that past research on energy tax incentives' effectiveness provides no definite answers. While some studies have reached tentative conclusions, several ongoing Department of Energy studies may supply additional valuable information which can be useful for deciding whether or not to modify the incentives.



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UNITED STATES GENERAL ACCOUNTING OFFICE

WASHINGTON, D.C. 20548

ENERGY AND MINERALS  
DIVISION

E-206345

The Honorable Don Fuqua, Chairman  
The Honorable Larry Winn, Jr.  
Ranking Minority Member

The Honorable Hamilton Fish, Jr.  
Ranking Minority Member, Subcommittee on  
Energy Development and Applications

The Honorable Manuel Lujan, Jr.  
Ranking Minority Member, Subcommittee on  
Energy Research and Production

Committee on Science and Technology  
House of Representatives

Your May 12, 1981, letter requested that we examine (1) the ability of U.S. electric utilities to undertake future energy research and development (R&D) activity in light of current Federal budget constraints and (2) the effectiveness of existing Federal tax incentives for energy production and conservation. In subsequent discussions with your office, we agreed to treat the request as two separate assignments. On September 28, 1981, we issued a letter report addressing electric utility R&D, which concluded that electric utilities will not undertake demonstrations on their own in several areas because of the financial requirements and risks involved. 1/

We further agreed to examine energy tax incentives in two phases. This report, which is the first phase product, reviews what is currently known about the energy tax incentives' effectiveness. We looked into the completed and ongoing studies of energy tax incentives and also investigated analyses on the effectiveness of other tax incentives to see if these analyses might help to understand the effects energy tax incentives have.

Our review showed that existing analyses are limited and provide no definite answers. However, some studies have reached tentative conclusions, and ongoing Department of Energy (DOE) efforts should supply valuable new information on the conservation and renewable tax credits. In our view, the work in progress may provide a better base for judging the performance of these tax incentives. According to DOE, most of the ongoing studies are expected to be completed by mid-1982. We plan to discuss the need for our second phase work with your office in light of the results of these ongoing studies.

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1/"Analysis of Federal Funding for Electric Utility R&D Projects",  
EMD-81-145, Sept. 28, 1981.

SCOPE AND METHODOLOGY

Numerous tax incentives have been enacted to encourage energy conservation and production. Three general categories of Federal energy tax incentives are tax credits, tax deductions in excess of expenses incurred, and deferrals of tax payments. These incentives are available for various energy activities. Tax credits for certain solar energy property is an example of the first category, the oil depletion allowance of the second, and expensing intangible drilling and development costs of the third.

As agreed with your office, the scope of this report is confined to the tax incentives for conservation and alternative energy sources contained in the Energy Tax Act of 1978 (P.L. 95-618) and the Crude Oil Windfall Profit Tax Act of 1980 (P.L. 96-223). The majority of the incentives contained in these laws are tax credits. Appendix II describes the specific tax incentives available under these two laws.

In conducting our study, we interviewed officials and reviewed documents from the DOE, the Department of the Treasury, and the Internal Revenue Service (IRS). We held discussions with the staffs of the Office of Management and Budget (OMB), the Joint Committee on Taxation, the Congressional Budget Office, the Congressional Research Service, and the Office of Technology Assessment.

Our analysis is also based on information from private organizations, academic institutions, published literature, and past GAO work. In particular, we reviewed and evaluated seven studies which deal with energy tax incentives for conservation and alternative energy and identified five others which are now in preparation. Appendix I contains details on the authors, completion dates and the specific tax incentives covered in the studies surveyed.

The effectiveness of a tax incentive is commonly defined in terms of how well the incentive stimulates new investment which would otherwise have not occurred. This criterion, however, addresses just one part of the issue. Moreover, in the case of energy, increased investment may not necessarily mean increased energy conservation or production. To guide our review, we thought of effectiveness in terms of how the value of the energy savings or increased production (induced by the energy tax incentive) compares to the value of the revenue foregone to the Federal Government.

Therefore, in examining the studies and other relevant material, we looked for information on: (1) the role that tax incentives play in stimulating energy investments, (2) reliable, current estimates on the energy savings or production effects of the energy tax incentives contained in the laws previously mentioned; and (3) estimates of the cost to the Treasury of providing these incentives.

Finally, in an attempt to place the issue in perspective, we examined what is known about the effectiveness of other tax incentives. We did this to determine how effective other tax incentives are and how they could be useful in analyzing the energy tax incentives. This investigation required performing four tasks: (1) identifying the tax incentives available in other areas, (2) discussing with Federal Government officials the state of knowledge on the effectiveness of the identified tax incentives, (3) identifying current and reliable studies on the subject, and (4) selecting a reasonable number of tax incentives for review.

OMB's Special Analyses, Budget of the United States Fiscal Year 1982, was used to identify the existing tax incentives. We asked officials from the Departments of the Treasury, Commerce, Interior, Labor, and Housing and Urban Development if they had analyzed the effectiveness of tax incentives affecting their areas of responsibility. These officials informed us about available studies on the subject. We then selected the incentives which had large budgetary impacts, were similar in structure to the specific energy tax incentives reviewed in this study and/or had been in effect for a relatively long time.

The incentives chosen were the Investment Tax Credit, Deferral of Income of Domestic International Sales, the oil depletion allowance and intangible drilling cost deduction. We looked most closely at the Investment Tax Credit which has been in effect since 1962 by reviewing economic literature on this subject. The Investment Tax Credit has the largest budgetary impact among available tax credits, according to OMB's tax expenditure estimates. Our review was performed in accordance with GAO's current "Standards for Audit of Governmental Organizations, Programs, Activities and Functions".

#### INFORMATION ON THE EFFECTIVENESS OF ENERGY TAX INCENTIVES IS INCONCLUSIVE

How much tax incentives stimulate conservation and alternative energy investment is still an open question. Furthermore, we believe the analyses conducted to date do not provide a solid base for determining how effective energy tax incentives are. The studies reviewed indicate that the numerous complex factors influencing investment decisions make it difficult to determine precisely what impact energy tax incentives have.

A comprehensive assessment of the energy tax incentives contained in the Energy Tax Act (1978) and the Crude Oil Windfall Profit Tax Act (1980) has not been performed. Few relevant studies have been undertaken, and some of these are not yet completed. (See appendix I.) Moreover, the more current analyses on residential energy conservation tax credits are preliminary. Existing analyses on the effects of alternative energy tax incentives focus only on tax credits for solar and wind energy equipment. The Brookhaven

National Laboratory's ongoing study on business energy tax incentives, which has a broader scope, is scheduled for completion by the end of March 1982.

DOE--which sponsored most of the studies--has no official position on the effectiveness of energy tax incentives. The Department is developing the data and analytical framework needed to evaluate their performance.

Lack of data has inhibited progress in analyzing energy tax incentives. The Internal Revenue Service's, Statistics of Income, which provides data on energy tax credits claimed is an important source of information. But while these data are useful, they are not conclusive since they do not indicate whether energy investments are made as a result of the tax credit. Moreover, the Statistics of Income data are highly aggregated and are particularly inadequate for analyzing the renewable energy tax credits.

Notwithstanding these limitations, the analyses to date provide valuable information on the tax credits' role in stimulating energy investment, and the number of taxpayers claiming credits.

#### Tax credits' role in stimulating energy investment

The studies we reviewed suggest that a tax credit may not have a substantial effect in altering economic behavior unless it is relatively large. According to the studies the initial capital cost is one among many factors affecting energy investment behavior.

Among other factors influencing energy investment decisions which the studies cite are

- perceived fuel cost savings,
- rising energy prices,
- industry vulnerability to fuel supply disruptions,
- availability of other Federal assistance programs,
- geographical location,
- characteristics of the investors (e.g., income level and implicit discount rate),
- information programs (e.g., audits and manufacturers' marketing practices),
- perception of risk,
- whether neighbors invested,

--housing characteristics, and

--investor's desire to support a new technology and be a pioneer in its application.

The studies' preliminary findings suggest that perceived savings in fuel bills appear to be more important than the initial capital cost in decisions concerning residential energy conservation investments. The studies imply that the conservation tax credit seems to be too small to significantly encourage investment.

Two studies also suggest that the business tax credits may accelerate the time in which investments are made, but rising energy prices would have made the investments attractive within a few years. The studies indicate that the business tax credits are too small to significantly affect the short payback period demanded by business. The analyses of tax incentives for industrial solar equipment suggest that the rate of increase in energy prices plays a major role in developing a market for this equipment.

#### Overview of the studies surveyed

We identified 12 studies which address conservation and alternative energy tax incentives. As shown in appendix I, seven of these have been completed, four are scheduled for completion by mid-1982, and one by next fall.

Among the completed studies, those prepared by Arthur D. Little and the Urban Systems Research and Engineering, Inc., deal with the tax credits for industrial solar and wind technologies (e.g., solar ponds, flat plate collectors, and wind turbines). Both studies analyze the effects of tax incentives on the market development of these technologies over the next decade, and the impact on the Federal Government tax revenues. According to a DCE official from the Office of Conservation and Renewable Energy, both studies were done for the same DOE office. The idea was to compare results using different methodologies in the analysis.

The Arthur D. Little study examines the market development of the solar technologies through 1991 and projects energy savings and estimates the net cost to the Government of providing the tax incentives. The analysis is done for investment tax credit levels of 10, 25, 40, 55, and 70 percent. The study concludes that the value of energy savings outweighs the cost of the tax credit to the Government. However, the analysis is based on the assumption that tax credits result in a net increase in total investment in the economy and do not simply shift resources from one investment to another. The study provides no evidence to prove this. Past studies on the Investment Tax Credit (ITC) suggest that the ITC changed the composition of investment but that effects on the total amount of investment in the economy as a whole are uncertain. (See p. 9.) If the tax credits do not stimulate new investment in

the entire economy, the results of the study regarding the net effect on tax revenues might be substantially different.

The study also states that the companies which invested in solar equipment did so for noneconomic reasons (e.g., fear of conventional fuel shortages, and desire to experiment with a new technology).

The Urban Systems Research study estimated the effects of various tax incentives on the economics of solar and wind technologies and the impact on Federal tax expenditures over the next 10 years. The study concludes that the profitability and competitiveness of solar equipment are highly sensitive to the levels of tax credit, borrowing, and the real rate of increase in energy prices. More importantly, the study suggests that the differential between energy price increases and the general inflation rate might be the most important factor in the market development for solar equipment over the next decade. The study also says that a rapid substitution of solar for conventional equipment may not occur even if the current solar business investment tax credits are extended through 1990.

Concerning the effects of Federal tax revenues, the study concludes that the Federal Government can recover the cost of the credits for solar direct heat equipment over the lifetime of the equipment but would not in the case of solar steam equipment.

The studies by ICF Incorporated and Charles River Associates deal with residential energy conservation tax credits. Both were largely dedicated to developing a theoretical framework and the data needed for the analyses.

The ICF study measures the importance of various factors in inducing household investment in energy conservation devices. ICF examined a limited number of conservation items, e.g., insulation, storm windows and doors, and solar water heaters. The study suggests that as energy prices rise, energy investment decisions are more likely to be guided by perceived energy savings than by the lowered initial capital cost of an energy conservation device. For example, the study indicates that a 10-percent savings in energy bills resulting from attic insulation would increase the probability that a household would insulate by 4 percent. However, a 10-percent reduction in the cost of installing insulation would increase the probability of investment by only 1 percent. This finding suggests that rising energy prices may be a key element in stimulating energy investments. However, this conclusion was not adequately supported. Overall, the results of this study are tentative, and the analysis is limited to a few energy conservation devices.

The Charles River study analyzes the tax credits' social net benefits and cost to the Federal Government. It develops a framework to determine how Federal funds can be allocated



among the various residential energy tax credits. The study tentatively found that insulation and storm windows save more energy per Government dollar invested than do solar water heaters and storm doors. However, the authors acknowledged that some of the assumptions used in the study are subject to certain caveats and the model is currently under revision. Followup work to this analysis is expected for completion this month.

The study by the Council of State Planning Agencies examines the experience of States which have adopted similar tax incentives. It discusses advantages and limitations of tax credits but concludes that the large number of factors influencing investment decisions make it difficult to measure the tax credits' effectiveness.

The studies by the Energy Information Administration (EIA) and Oak Ridge National Laboratory compared tax credits with other energy policy options (e.g., taxes on fuel use). The EIA study conducted in 1978, estimates the energy conservation effects of several measures associated with the 1977 National Energy Plan. One of the study's major findings is that the energy conservation and solar credits would reduce fossil fuel use by only 0.7 quads in 1985. 1/

Oak Ridge compared the performance of three policy options--building energy performance standards, energy investment tax credits and fuel use taxes. The study found that a 40-percent tax credit, a 15-percent fuel use tax, or the building performance standards would achieve the same savings by the year 2000.

The Oak Ridge and Brookhaven National Laboratories are currently working on two broader studies. The Oak Ridge work should provide better data on who has claimed the residential energy conservation and solar tax credits and the basis for investments. For example, it would provide information on the distribution of claimants by income group and region, and why the investment was made. The results of this work will ultimately be used to calculate the energy savings effects of the credits.

The Brookhaven study will examine many of the business tax credits for conservation and renewable energy investments contained in the 1980 Tax Act. This work will attempt to estimate energy savings and cost associated with the credits.

The Solar Energy Research Institute (SERI) has undertaken a study on the effectiveness of tax credits for residential solar water heaters. The work will be based on statistical methods and IRS data on tax credits claimed. SERI's work will examine Federal and State tax credits for all 50 States.

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1/ A quad equals 1 quadrillion British thermal units.

The Congressional Research Service's study will examine the energy, distributional and allocation effects of existing Federal energy tax credits for residential conservation equipment. Specifically, the study should provide information on the extent to which tax credits stimulate increased energy conservation; the income groups participating in the residential energy tax credit program, and the extent to which tax credits prove efficient in allocating resources in the economy.

A more detailed discussion of the studies' findings and methodologies is contained in appendix II.

Millions of taxpayers participated  
in the Tax Credit Program

Although the role tax credits play in stimulating energy investments is not clear, many taxpayers have claimed Federal energy tax credits since their enactment in 1978. IRS data show that over 16 million taxpayers claimed credits in 1978 and 1979 amounting to \$1.4 billion. <sup>1/</sup> The data also show more credits claimed in 1979 tax returns than in 1978 returns. In the residential sector, the largest increase was in renewable energy expenditures, which went up by 145 percent. <sup>2/</sup> In the business sector, the number of returns claiming credits rose by 200 percent. While these figures are impressive, an unanswered question is whether the credits are indeed incentives or instead provide windfalls to most taxpayers who claim them. A more detailed discussion of the IRS energy tax credit data is contained in Appendix III.

ANALYSES OF OTHER TAX INCENTIVES ADD PERSPECTIVE  
BUT PROVIDE NO DEFINITE ANSWERS ON EFFECTIVENESS

To obtain a broader perspective on the possible effects of energy tax incentives, we looked into analyses of other tax incentives. This effort was also intended to determine whether ongoing analyses of the conservation and renewable energy tax incentives are likely to enhance our understanding of their effectiveness.

Our review of existing literature and interviews with Federal Government officials indicated that few analyses have been conducted on the effectiveness of other tax incentives. Among the exceptions are: the Investment Tax Credit, the Domestic International Sales

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<sup>1/</sup>Includes energy investments made over the last 8 months of 1977 because the Energy Tax Act of 1980 applies to expenditures made on and after April 1977.

<sup>2/</sup>Based on IRS data standardized to exclude expenditures made during 1977. The 145-percent increase represents an upper limit estimate. See app. IV, p. 19.

Corporation (DISC), and the oil depletion allowance and the deduction of intangible drilling costs. <sup>1/</sup> The studies show that these tax incentives have succeeded in their goal of increasing investment in the desired areas. This finding suggests that energy tax incentives may also have the same effect. However, the studies do not make the case that investments were increased efficiently or that these incentives were the most effective way of stimulating investment. That is, the studies provided no evidence suggesting that the Federal Government received a reasonable return for the revenue lost through these incentives. Consequently, while these tax provisions may indeed cause increased investment, one cannot argue by analogy and say that these incentives--and so energy tax incentives--are efficiently diverting resources to the desired activities.

The Investment Tax Credit, which has been in effect since 1962, provides an incentive for firms to purchase new machinery and equipment and was designed to promote economic growth. Specifically, this credit aimed at permanently increasing the fraction of the gross national product that is allocated to investment in machinery and equipment. The tax credit for machinery and equipment would contribute to economic growth to the extent that such investments are more productive than other forms of capital.

Studies on this subject indicate that the investment credit changed the composition of investment towards machinery and equipment and away from other sectors, especially real estate. However, the extent to which the credit stimulates new investment in the entire economy, and thus increases growth is uncertain. The studies in this area also indicate that much of the investment that the tax credit rewards would have been made anyway.

DISC is a special corporation that allows the deferrals of income tax on a portion of export profits. Under the Revenue Act of 1971, the Secretary of the Treasury is required to submit an annual report to the Congress analyzing the operation and effect of the DISC legislation on the level and structure of U.S. trade. The June 1980 Treasury report concludes that DISC stimulated additional exports from July 1978 to July 1979. According to this report, the DISC provisions resulted in an increase in U.S. exports of between \$4.5 and \$7.0 billion over what they otherwise would have been during that time.

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<sup>1/</sup>For further information on these subjects see, General Accounting Office, "Investment Tax Credit: Unresolved Issues," PAD-78-40, May 8, 1978; Department of the Treasury, The Operation and Effect of the Domestic International Sales Corporation Legislation 1979 Annual Report, April 1981; and Battelle Memorial Institute, "An Analysis of the Results of Federal Incentives Used to Stimulate Energy Production." June 1980.

The percentage depletion allowance and intangible drilling cost deduction are among the largest and oldest tax incentives that have been instituted. The Battelle study examines, among other things, the cumulative effect of these incentives on oil output and prices. 1/ According to the study, these incentives together increased crude oil production between 3 and 10 percent and reduced oil prices about 10 to 25 percent over the period 1950 to 1977. The wide range in the estimates reflects the lack of consensus among experts on the impacts of these incentives. These disagreements arise because numerous other factors affected output and prices during that time period.

#### SUMMARY

The U.S. Government currently has limited information on the effectiveness of Federal tax incentives for energy conservation and production of alternative energy sources. Some studies have reached tentative conclusions and ongoing efforts should supply valuable new information. The Government also has performed few analyses of the effects tax incentives have in other areas of the economy.

The findings of the studies sponsored by DOE and the Council of State Planning Agencies which have been completed suggest that:

- The initial capital cost is one among many factors influencing energy investment decisions.
- Households' energy investment decisions are likely to be more affected by the expected savings in energy bills during periods of rising energy prices than by a reduction in the initial capital cost of the energy savings device.
- The rate of increase in energy prices relative to the general inflation rate might be the most important factor in the market development of solar equipment for industrial use over the next decade.
- Insulation and storm windows save more energy per Government dollar invested than do solar water heaters and storm doors.
- Tax credits may accelerate the time in which investments are made but rising energy prices would make the investment attractive within a few years.
- To be effective in stimulating new investment a tax credit has to be quite large.

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1/The study assumed a depletion allowance of 27.5 percent for oil.

- Industrial users have invested in solar energy equipment for noneconomic reasons but greater use of the technology may depend on favorable economics.
- Under certain assumptions about future energy prices, tax credit levels and economic activity, the Government might recuperate tax credit expenditures in solar energy equipment over the next decade.

These findings provide some insight into the tax effectiveness issue, but because in many cases they are preliminary and limited to a few residential energy conservation and renewable tax incentives, they do not provide a solid foundation for formulating policy. No current reliable estimates are available on the energy savings or the production effects for the majority of the tax incentives available.

The administration is considering proposing changes to existing legislation to modify or repeal certain energy tax incentives as part of a proposal for curbing the budget deficit. To judge whether to keep, abolish, or change the existing energy conservation and renewable tax incentives will require, at a minimum, confirming the available findings on residential conservation tax credits and examining the role of the business energy tax incentives. DOE has four studies in process which aim at testing past findings and filling in major gaps in the present information base. According to DOE officials from the Office of Policy, Planning and Analysis, and the Office of Conservation and Renewable Energy, the ongoing work is designed to provide information on

- energy savings and costs of most business energy tax incentives available under the Energy Tax Act and the Crude Oil Windfall Profit Tax Act,
- energy savings per Government dollar invested in residential conservation and solar equipment, and
- energy investment activity induced by the tax credits over the past several years (e.g., solar, conservation) by region and income group.

In our opinion, appropriate methodologies, such as engineering and econometric modeling, are being used to conduct the analyses. These studies should provide a better understanding of the role of energy tax incentives.

Government analyses of tax incentives in other areas are also limited. But the available studies show that the tax incentives increased investment in the desired activities. However, these studies do not state whether the the Government obtained a reasonable return on the expenditure or if the tax incentive was the best

way to stimulate new investment in the particular activity. These studies, therefore, provide some guidance but no definitive answers on the effectiveness or efficiency of tax incentives.

AGENCY COMMENTS  
AND OUR EVALUATION

We provided draft copies of this report to the Departments of the Treasury and Energy for review. Their official comments are attached as appendices V and VI.

Both Departments agreed with the report's conclusions that existing tax credit studies provide no definite answers and that ongoing analyses will supply valuable information on the energy tax credits' effectiveness. However, they indicated that evaluating the results of a broad energy tax credit program is difficult and that additional studies can only provide estimates. DOE also said that the report implied that additional studies on the effectiveness of tax credits would provide definitive information and that this may be misleading. We considered this interpretation and modified our final report accordingly.

Treasury's basic point was that recent changes in tax law (The 1981 Economic Recovery Tax Act) and oil price decontrol have made the tax incentives obsolete. Treasury asserted that the real issue is whether the tax incentives should be continued. Since we were requested to look into their effectiveness only, we did not address this question. We note that the need for tax incentives has not been either established or disproved and that this is a legitimate subject for continuing investigation.

We continue to believe that the ongoing energy tax credit studies, most of which according to DOE would be completed by mid-1982, will enhance the present information base. As indicated on pages 10 and 11, existing analyses are preliminary, limited to a few tax credits, and provide no current estimates on energy savings nor on costs of the major energy tax incentives presently available. As discussed earlier, the work in progress is designed to test preliminary findings and fill in major gaps in the existing information base. We believe decisionmakers would benefit from that type of information. However, we recognize that these studies are not likely to provide definitive answers and that in the last analysis Congress will have to judge whether or not to change the existing incentives.

DOE also supplied information on three additional DOE-sponsored tax credit studies. Two of these studies were recently completed and the other is still in process. The Department also provided updates on deadlines for completing its ongoing work. We have incorporated this information in our report.

B-206345

Copies of this report are being sent to the Director, Office of Management and Budget, the Secretary of Energy, and the Secretary of the Treasury.



J. Dexter Peach  
Director





C o n t e n t s

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**Principal Studies on Energy Tax Incentives Conducted to Date**  
Completed Studies

Title	Author	Sponsor	Date	TAX INCENTIVES	
				Residential Credits	Business Credits
"The Cost of Federal Tax Credit Programs to Develop the Market for Industrial Solar and Wind Energy Techniques"	Arthur D. Little contracted by University of California, Lawrence Livermore Laboratory	Conservation and Renewable Energy Office, U.S. Department of Energy	November 1981	None	Tax credit for solar and wind energy equipment
"Analysis of the Impact of Federal Tax Incentives on Market Diffusion for Solar Thermal/WECS Technologies: 1980-1990"	Urban Systems Research and Engineering, Inc. Contracted by University of California Lawrence Livermore Laboratory	Conservation and Renewable Energy Office, U.S. Department of Energy	October 1981	None	Tax credit for investment in solar and wind equipment
"Analysis of Conservation Improvements and Retrofit Changes in the Residential Sector"	ICF Incorporated and Mathematica Policy Research	Office of Policy, Planning Analysis and Energy Information Administration, U.S. Department of Energy	June 1981	Credit for: --storm windows/doors --wall/roof insulation --weatherization/caulking --automatic thermostat, etc.	None
"An Analysis of the Residential Energy Conservation Tax Credits: Concept and Numerical Estimates"	Charles River Associates, Inc.	Office of Policy, Planning and Analysis, U.S. Department of Energy	May 1981	Tax credit for: --roof and wall insulation --storm windows and doors --solar hot water heaters	None
"A Simulation Analysis of Alternative Policies to Stimulate Energy Conservation in Commercial Buildings"	Energy Division, Oak Ridge National Laboratory	Conservation and Solar Energy and the Energy Information Administration, U.S. Department of Energy	November 1980	None	--Tax credits for investment in efficiency improvements --Taxes on fuel use
"State Conservation and Solar Energy Tax Programs: Incentives of Windfalls"	Leonard Rodberg and Meg Schachter	The Council of State Planning Agencies	1980	--State property tax and sales tax exemptions for conservation and solar equipment --State income tax deduction/income tax credit for conservation and solar equipment	--State property tax and sales tax exemptions for conservation and solar equipment --State income tax deduction/income tax credit for conservation and solar equipment
"An Evaluation of Energy Related Tax and Tax Credit Programs"	Office of Integrative Analysis, Energy Information Administration U.S. Department of Energy	None	July 17, 1978	Credit for: --conservation equipment (insulation, storm windows/doors, etc.) --solar heating, water heating, and cooling of buildings	Credit for: --conservation equipment (insulation, storm windows/doors, etc.) --solar heating, water heating and cooling of buildings --investment in non-oil or non-gas, energy-related facilities or coal-fired, co-generation facilities

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Principal Studies on Energy Tax Incentives Conducted to Date

Ongoing Studies

Title	Author	Sponsor	Estimated Completion Date	TAX INCENTIVES	
				Residential Credits	Business Credits
(Untitled) Analysis of Correlation Between Energy Tax Credits and Various Factors	Oak Ridge National Laboratory	Office of Policy, Planning and Analysis, U.S. Department of Energy	Middle of fiscal year 1982	Credit for: --conservation equipment --solar heating/cooling	None
"Economic Analysis of Selected Provisions of the 1978 Energy Tax Act"	Brookhaven National Laboratory	Office of Policy, Planning and Analysis, Division of Finance and Tax Analysis, U.S. Department of Energy	End of March 1982 (draft final report)	None	Tax Credit for: --alternative energy property --solar and wind energy --waste heat recovery equipment --municipal waste recycling equipment --shale oil equipment --equipment for gas from geopressurized brine --ocean-thermal energy equipment --small scale hydro-electric equipment --co-generation equipment --intercity buses
"An Analysis of the Residential Energy Conservation Tax Credits: Concepts and Numerical Estimates"	Charles River Associates, Inc.	Office of Policy, Planning and Analysis, U.S. Department of Energy	February 1982 (draft final report)	Follow-on work to May 1981 study using revised assumptions	None
"Economic Evaluation of Federal Tax Credits for Residential Conservation"	Congressional Research Service		Late February 1982	Tax credit for energy conservation equipment	None
(Untitled) Analysis of the Renewable Energy Tax Credits	SERI	Conservation and Renewable Office, U.S. Department of Energy	Fall 1982	Tax credit for solar water heaters	None

DESCRIPTION OF EXISTING FEDERAL  
TAX INCENTIVES FOR ENERGY CONSERVATION  
AND ALTERNATIVE ENERGY SOURCES 1/

The principal Federal tax incentives designed to promote energy conservation and the production and use of alternative energy are contained in the Energy Tax Act of 1978 (P.L. 95-618) and the Crude Oil Windfall Profit Tax Act of 1980 (P.L. 96-223). Incentives are available for specific residential and business energy expenditures.

The residential energy tax incentive is a credit against a homeowner's income tax for investment made in conservation and renewable energy equipment. The credit applies to expenditures made on or after April 20, 1977, and expires on December 31, 1985. The credit can only be claimed once for an individual's principal residence. The conservation credit allows a person to subtract from income taxes due, 15 percent of the first \$2,000 (up to \$300) for conservation investments. The renewable tax credit is 40 percent for the first \$10,000 investment (up to \$4,000) in renewable source equipment.

The business energy tax credit provision modifies the business investment credit to encourage conservation of, or conversion from, oil and gas or to encourage new energy technology. In addition to the existing 10-percent investment tax credit, a credit is available for expenditures on energy property. The amount of the credit allowable and the eligibility period vary depending on the type of energy property.

The specific tax incentives for energy conservation and alternative energy production contained in the Energy Tax Act include:

Residential Incentives

- Tax credit for solar, wind, and geothermal energy property used to heat, cool, or supply hot water or wind energy to a residence.
- Tax credit for the purchase of insulation, furnace replacement burner, flue-opening modifier, furnace ignition system, storm or thermal window or door, automatic energy-saving setback thermostat, caulking or weatherstripping, meter displaying energy usage cost, and any item specified by regulation by the

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1/Alternate energy as used in this report refers to renewable energy and fuels other than crude oil and natural gas and their products.

Secretary of the Treasury as increasing energy efficiency.

Business Incentives

- Credit for equipment which uses solar or wind energy to generate electricity or to heat or cool a structure.
- Tax credit for equipment used to produce, distribute, or use geothermal energy.
- Intangible drilling cost deductions and percentage depletion allowance for geothermal resources and geopressured brine.
- Tax credit for boilers, burners, and pollution control and handling equipment for biomass fuel.
- Exemption from the Federal gasoline excise tax for gasoline mixed with alcohol (gasohol).
- Tax credit for certain equipment used to sort and prepare or recycle solid waste.
- Tax-exempt industrial bonds used to finance solid waste recycling.
- Tax-exempt bonds used to finance electric energy facilities owned or operated by State or local governments.
- Tax credit for equipment used to produce shale oil and natural gas from geopressurized brine.
- Tax credit for vanpooling provided by employers.
- Tax credit for certain equipment used to convert an alternate substance into synthetic liquid, gaseous, or solid fuel; unload, transfer, store, or prepare alternate fuels; and for equipment needed to control pollution or modify existing units to permit use of alternate fuel or mix with it.
- Tax credit for specifically defined energy property including a recuperator, heat wheel, regenerator, heat exchanger, waste heat boiler, heat pipe, automatic energy control system, turbulator, preheater, combustible gas recovery system economizer, or item specified by the Secretary of the Treasury.
- Removal of excise tax on buses.
- Refund of excise tax on intercity, local, and school buses.

- Exemption of excise tax on lubricating oil used to produce re-refined oil.

Included in the Crude Oil Windfall Profit Tax Act are:

Residential Incentives

- Tax credit for solar and geothermal electric energy and solar panels which are structural component of a dwelling unit.

Business Incentives

- Tax credit for solar equipment used for industrial, agricultural, or commercial process heat.
- Credit for small scale hydroelectric facilities.
- Tax credit for synthetic fuels (for equipment used for processing coke or coke gas and for converting coal into chemicals or other products or into methanol, ammonia, or hydroprocessed coal, liquid, or solids).
- Cogeneration tax credit (for equipment added to existing boilers or burners).
- Tax credit for certain intercity buses.
- Tax credit for alcohol fuels and alcohol fuel mixtures.
- Tax exempt bonds to finance property used to convert solid waste into steam or alcohol.
- Tax credit for producers of fuel from nonconventional sources.
- Oil from shale and tar sands; gas from geopressured brine, Devonian shale, coal seams, tight formation, or biomass; synthetic fuels from coal; processed wood fuels; and steam from solid agricultural by-products.
- Tax exempt bonds for qualified hydroelectric generating facilities.
- Tax credit for certain ocean thermal energy projects.

SUMMARY OF MAIN STUDIESAVAILABLE ON TAX INCENTIVES FOR CONSERVATIONAND ALTERNATIVE ENERGY SOURCES

This appendix summarizes the 12 studies on conservation and alternative energy tax incentives which we reviewed. Of these, seven have been completed, four are scheduled for completion by the spring of 1982, and one for this fall.

The studies' objectives vary; therefore, each study examines different aspects of tax incentives. The summaries presented here highlight the conclusions of the studies that relate most closely to our concern--the effectiveness of energy tax incentives in stimulating increased conservation and the development of alternative energy sources.

Results of several studies are preliminary, and some are currently under revision. Various studies employed simulation techniques to project energy savings. When such analyses were based on past data which do not accurately reflect the present energy situation, their results remain to be proven.

Some recent studies are somewhat complex, and employed sophisticated conceptual frameworks and empirical analyses. But as acknowledged by the authors, the results are subject to certain limitations on the assumptions and data used.

The main studies reviewed are:

- Arthur D. Little, The Cost of Federal Tax Programs to Develop the Market for Industrial Solar and Wind Energy Techniques. Prepared for the Lawrence Livermore Laboratory, University of California. November 1981, Cambridge, Massachusetts.
- Urban Systems Research and Engineering, Inc. Analysis of the Impact of Federal Tax Incentives on the Market Diffusion for Solar Thermal/WECS Technologies. Prepared for the Lawrence Livermore Laboratory, University of California. October 1981, Washington, D.C.
- ICF, Inc. and Mathematica Policy Research, Analysis of Conservation Improvements and Retrofit Changes in the Residential Sector. Prepared for the Office of Policy, Planning and Analysis and the Energy Information Administration, U.S. Department of Energy, June 1981, Washington, D.C.
- Charles River Associates, Inc. An Analysis of the Residential Energy Conservation Tax Credits: Concepts and Numerical Estimates. Prepared for the Office of



Planning, Analysis and Evaluation, U.S. Department of Energy, June 1981. Boston, Massachusetts.

- Leonard Rodberg and Meg Schachter, State Conservation and Solar Energy Tax Programs: Incentives or Windfalls? The Council of State Planning Agencies, Washington, D.C., 1978.
- Oak Ridge National Laboratory. A Simulation Analysis of Alternate Policies to Stimulate Energy Conservation in Commercial Buildings. Prepared for the Conservation and Solar Energy Office and the Energy Information Administration, U.S. Department of Energy, November 1980.
- Energy Information Administration, U.S. Department of Energy. An Evaluation of Energy Related Tax and Tax Credit Programs, July 17, 1978.
- Charles River Associates [follow-up work to their June 1981 report]. Draft final report scheduled for completion on February 15, 1982.
- Brookhaven National Laboratories. Economic Analysis of Selected Provisions of the 1978 Energy Tax Act. Prepared for the Office of Policy, Planning and Analysis, U.S. Department of Energy. Draft final report scheduled for completion on March 31, 1982.
- Oak Ridge National Laboratory. Analysis of the Correlation Between Energy Tax Credits and Various Factors. Prepared for the Office of Policy, Planning and Analysis and the Conservation and Renewables Office, U.S. Department of Energy. Scheduled for completion by mid-1982.
- Solar Energy Research Institute. Analysis of Tax Credits for Residential Solar Water Heaters. Scheduled for completion in the fall of 1982.
- Congressional Research Service. Economic Evaluation of Federal Tax Credits for Residential Conservation. Estimated issue date, end of February 1982.

The following provides a synopsis of each study mentioned above.

ARTHUR D. LITTLE, INC., NOVEMBER 1981

The study examines two major aspects of renewable energy tax credits: (1) their effects on the industrial market acceptance of solar and wind energy technologies, over the next decade and (2) their impact on Treasury finances. The specific renewable technologies examined are: solar ponds, flat plates, evacuated tube, parabolic troughs and wind turbines. The study projects to 1991

the market development for these technologies, the conventional source of energy displaced, and the net cost to Treasury of providing the tax credits. The analysis is done for investment tax credit levels of 10, 25, 40, 55 and 70 percent, which are assumed constant to 1991.

Under present legislation, renewable energy equipment is eligible for a 15-percent tax credit and, in some cases, also for the 10-percent investment tax credit. The renewable energy tax credit, however, expires in 1985. Therefore, the study looked at the impact of present legislation and the potential effects of maintaining or increasing the renewable energy tax credits beyond 1985.

The approach used in the study consisted of market penetration models and economic analysis. To examine the industrial market for renewable energy devices, the authors first performed an economic analysis of each of the proposed renewable energy devices for five different levels of tax credits at each of seven resource levels. Second, they gathered and processed data on industrial energy use, state wide energy use, wind and solar resource levels, and fuel costs. These data, and the economic analysis, were the inputs to the market penetration model. Market penetration modeling was then performed.

For information on early sales of the technologies, the authors interviewed nine firms located around the United States. The companies provided information on the criteria they used in purchasing solar and wind systems.

To determine the impact tax credits have on Treasury, the authors estimated: (1) the direct tax revenues lost from the credits, (2) the additional tax revenue resulting from the increased economic activity generated by the investment in solar and wind systems, (3) the additional tax revenue associated with higher profits resulting from fuel savings, and (4) the loss of tax revenue resulting from the decreased sales of conventional fuels.

The final step in the analysis was to calculate the net effect on Treasury's tax revenue. To this end, the authors calculated the difference between the present value of energy savings and the present value of the tax credits' cost to Treasury.

The study concludes that the value of energy savings exceed the tax credits' cost to Treasury. This conclusion appears to be valid for tax credit levels up to 70 percent (a 60-percent renewable energy tax credit) under both the low- and high-inflation rate scenario (an energy inflation rate of 3 or 9 percent above the general inflation rate, respectively). According to the study, under the high-inflation scenario, the energy savings associated with the tax credits would not only outweigh this cost but would provide Treasury with additional tax revenue over the next decade.

In our view, the study's results are highly dependent on a strong economic assumption. In calculating the impact of the tax credits on Treasury finances, the study assumed that the tax credits lead to net new investment in the economy and do not merely shift resources from one investment to another. The study makes no sound argument to support this assumption. Past studies on the Investment Tax Credit indicate that (1) there is no evidence to support that the credits generate increased total investment, but (2) past analysis show that the ITC changed the composition of investment. (See p. 9.) The assumption made by the authors is crucial to this study because if the tax credit does not result in a net increase in investment, the gains in Treasury's tax revenue will be lower. Consequently, the net effect on Treasury finances may be substantially different.

The A.D. Little industry survey provides some interesting information on the companies' decision to invest in solar and wind technologies. According to the study, the companies said they invested for noneconomic reasons since the payback period was usually too long to justify the investment. The non-economic reasons given were:

- Fear of future price increases and shortages of conventional fuels.
- Desire to support the new technologies and be a pioneer in its application.
- Personal preferences and as a public relations tool.

These views suggest that tax incentives may not play a role in decisions concerning solar and wind systems. However, the authors indicated that while this may be true for some sales, the market development for these devices will depend on "favorable economics."

URBAN SYSTEMS RESEARCH AND ENGINEERING, INC., OCTOBER 1981

The scope of this study is similar to the one prepared by Arthur D. Little, but the approach used differs slightly. Both studies were prepared for DOE's Office of Conservation and Renewable Energy. According to a DOE representative from this office, the reports were commissioned with the idea of comparing results of studies which approach the issues differently. In our view, the methodologies employed are similar in the sense that both studies examined the economies and market penetration of the technologies. However, the specific models employed differ somewhat.

This study evaluates the effects of various tax incentives on internal rates of return for solar thermal and wind electric industrial equipment, develops estimates of market penetration for this equipment from 1980 to 1990, and assesses the net Federal tax

expenditures. The specific technologies examined are: solar ponds, flat plate collectors, evacuated tubes, and parabolic troughs. These technologies are used by industry for direct heat and process steam.

Among the tax incentives considered in the study are: the renewable energy tax credit; the investment tax credit; sum of the years depreciation schedule which is effective until 1985; and certain provisions of the Economic Recovery Tax Act of 1981 regarding depreciation, which will be in effect after 1985.

An internal rate of return model is used to analyze the profitability of the technologies. The analysis is done for a variety of tax scenarios and fuel escalation rates assuming that the solar equipment will be put in operation in 1985 or 1990. The study assumes that firms require an after-tax-rate of return of 20 percent and that solar systems would replace only oil- or gas-fired conventional systems. Data used in this model were supplied by the Energy Information Administration's End-Use Energy Consumption Data Base, and cost estimates by several private organizations.

The study concludes that the profitability and competitiveness of solar equipment are very sensitive to the level of tax credits available, the amount of borrowing used, and the real rate of inflation for energy prices. According to the study, the rate of increase in energy prices relative to the general inflation rate is probably the most important factor in projecting the market development for solar equipment. The study found that with a 2.8 percent per year real increase in energy prices (above the general inflation rate) during 1981-90 no solar equipment will be attractive before the year 2000. The exception was solar ponds which the study says, can achieve a target 20-percent internal rate of return by 1990 without excessive borrowing or additional tax credits. However, the analysis indicates that if the real annual inflation rate for energy is 8.3 percent, all technologies but one would attain at least a 20-percent internal rate of return under current tax law, with a 25-percent special business energy investment tax credit.

However, the authors indicate that even if the current solar business investment tax credits are extended through 1990, a rapid substitution of solar for conventional equipment will not occur. The study states that with the most optimistic projected market share, the solar thermal output in the South and Southwestern United States will total 0.02 quads at most in 1990. The authors further say that a 50 percent investment tax credit would only provide about 0.04 quads at best (or less than 5 percent of the relevant market for industrial direct heat and process steam equipment).

Regarding the impact on Federal tax revenues, the study concludes that the Federal government would increase total revenues over the life of the equipment by providing large tax credits in

the direct-heat market. In contrast, in the case of process steam equipment, Federal revenues are likely to decrease over the lifetime of the equipment.

ICF, INC., AND MATHEMATICA POLICY RESEARCH, JUNE 1981

The purpose of the study was to develop and estimate a model on households' energy conservation and retrofit behavior. Specifically, the study examines household decisions to invest in conservation items such as storm windows/doors, insulation, weatherstripping, and caulking. To this end, the authors reviewed recent trends in conservation and retrofit decisions and identified major factors which influence buying decisions. Among the key factors identified are: rising fuel prices, perceived energy savings, cost of the energy conservation device, household characteristics (i.e., income level, age, race, and education), and housing characteristics (i.e., location, thermal conditions, size, and age).

An econometric model was employed to test the significance of the various factors influencing investment decisions. The model related the cost of the equipment and the perceived savings in energy bills of the various conservation items to the probability of a household's investing in such equipment.

A preliminary finding was that households are more likely to respond to the expected savings in fuel bills than to the cost of the conservation equipment. For example, the study indicates that a 10-percent savings in the energy bills resulting from attic insulation would, on average, increase the probability of a household's insulating by about 4 percent. In contrast, a reduction of 10 percent in the cost of attic insulation would increase the probability of investment by only 1 percent. This implies that if households are more likely to respond to savings in energy bills, Government money would be more efficiently spent in developing efficient technologies to increase energy savings. The study also found that households headed by older individuals tend to invest less frequently, most conservation efforts were concentrated among households in single-family detached units and, that conservation activity increased with family income.

Most of the data used were drawn from other reports and surveys. The main information sources included: DOE, "National Interim Energy Consumption Survey," 1980; U.S. Bureau of Census, "Annual Housing Survey" (1975-1977); Oak Ridge National Laboratory; the American Gas Association; and the Office of Technology Assessment.

As acknowledged by the authors, the study findings are subject to certain caveats. The information available is limited, and the assumptions used to calculate perceived energy savings are optimistic according to the authors. Finally, the study only examines household behavior in 1977 and 1978. Present and future investment decisions need to be analyzed, taking into account

any changes in key variables such as the housing stock, general economic conditions, and fuel price expectations.

CHARLES RIVER ASSOCIATES, INCORPORATED, JUNE 1981

The purpose of this study was to develop an approach to examine the effects of residential energy conservation tax credits; identify the data needed to analyze these effects; and estimate the net social benefits, the energy savings, and cost to the Federal Government. The study examines household investments in roof and wall insulation, storm windows, and doors. These categories of investment accounted for 86.8 percent of total energy conservation expenditures in 1978 income tax returns. Investment in solar hot water heaters are also examined. The time period covered is 1977 to 1985. The study provides an analytical framework for allocating resources among the various residential energy tax incentives.

The study tentatively found that the net social benefit from energy tax credits is highest for wall insulation, storm windows, and roof insulation. The tax lost per barrel of oil saved is lowest for these same three categories, with roof insulation the lowest. This suggests that these devices provide greater energy-saving at the lowest governmental cost. Storm doors and solar water heaters result in high tax loss per barrel saved. These results suggest that the Government might achieve better results from energy tax credits by concentrating their application in the categories with the highest energy savings per Government dollar invested. However, since the estimates are preliminary, placing confidence in these findings is premature.

An econometric model was employed to estimate the impacts of the energy tax credits. The first step was to model household buying behavior by calculating the probability of investment in energy saving equipment. With this information, a market demand for energy-saving investment was derived. The next step was to determine the penetration of these investments by estimating an investment supply schedule and equating this to demand. These calculations were then used to estimate the social benefits and revenue losses as a result of the tax credits.

One of the key assumptions made was that the household's energy consumption behavior does not change after the investment is made. For example, households often leave the thermostat unchanged after purchasing insulation. However, because of the effect of insulation on energy bills, individuals have an option to set the thermostat at higher comfort levels and still pay less than without insulation. The authors of the report acknowledged that their energy savings estimates are probably overstated since households are likely to modify their energy use pattern after the investment is made.

Another critical assumption was that all households have the same discount rate and attitudes in analyzing investment decisions.

It was also assumed that the number of investments through time is a constant even though population changes over time. The study incorporates a "national security premium" to the price of imported oil. This premium was specified by DOE at \$4 per barrel. The authors acknowledge that other studies have placed a higher value to the national security costs. For example, the 1979 Harvard Energy Future report estimates the premium at between \$37 to \$87 per barrel of imported oil by the late 1980s. However, the Harvard estimates enhance other factors such as the impact of U.S. energy conservation on other nations actions or investors confidence, and on short-run costs adjustments from rapid price increases. 1/

With respect to the estimate on renewable resources, the analysis did not take into account the fact that the solar water heater is subject to economies of scale. Therefore, it is likely that the cost of production and the price to the end-user will be lower in the future as the solar water heater becomes more popular. Other factors which may induce investment in this device such as the psychological impact created by neighbors purchasing the solar equipment were excluded from the analysis. The performance of the heaters is likely to change if other relevant factors are taken into account. The authors acknowledged that the findings on solar investments underestimate the benefits of the solar tax credit because the model did not include these other factors.

The data used in the model were primarily from IRS, the National Interim Energy Consumption Survey, and other DOE reports. The model used is currently under revision and further work on the subject is scheduled for fiscal 1982.

LEONARD RODBERG AND MEG SCHACHTER, THE COUNCIL OF STATE PLANNING AGENCIES, 1978

The study discusses potential advantages and limitations of various energy financial incentives with emphasis on State energy tax incentives. Specifically, the study examines the experience of States which have adopted tax incentives to encourage energy conservation and renewable energy investments, mainly solar. The incentives discussed are property and sales tax exemptions, tax credits, and income tax deductions.

The study is generally descriptive (based on a review of previous empirical and theoretical studies on the subject), covering the period 1977-1979. But the authors also gathered and analyzed tax data from States that have enacted incentives. Such data included the number of people claiming the incentive, the size of the claim, and the distribution of claimants by income and type of investment made.

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1/R. Stobaugh and D. Yergin, eds., Energy Future: Report to the Energy Project at Harvard Business School, New York: Random House, 1979.

The authors contend that past studies examine the role of energy tax credits from too narrow a perspective, focusing on the price of the energy equipment and not taking into account the complexities of the investment decisionmaking process. Decision-making is complex because (1) numerous interacting economic and qualitative factors influence consumer choice and (2) different buyers have different investment criteria. The authors suggest that the existing analytical methods have not adequately captured such complexities.

The study concludes that it is not possible to clearly demonstrate how much tax incentives stimulate new investment in conservation and renewable energy. The study states that

"\* \* \* because of uncertainty about future energy prices and supplies, as well as a variety of subjective factors that affect the consumer's decision to purchase such an alternative, neither economic analysis nor attitudinal research is able to provide a firm basis for deciding on the appropriate level for State financial incentives or for predicting what their consequences will be."

However, the study draws conclusions about the conditions under which State tax incentives should and should not be pursued. The authors indicate that State tax incentives should not be used when a conservation or renewable energy investment is already cost effective, even if it is not being adopted. Tax incentives will be most useful when they alter the financial attractiveness of an energy investment that would otherwise not be attractive.

The study states that tax credits have played an important role in helping solar energy compete with conventional fuels in the residential sector, but no evidence for this is provided. The authors identify various disadvantages of credits. For example, because the credit is not received until the return is filed, it may not help the lower income consumer who finds it difficult to make the initial capital outlay. According to the study, the tax credit generally subsidizes middle- and upper-income households which might have invested in solar energy regardless of the credit. Individuals who have little or no tax liability do not benefit from the tax credits.

According to the study, existing tax programs in the commercial area have been fairly ineffective, because businessmen demand short payback periods and they can deduct fuel expenses. The study also says that any subsidy for solar devices would have to be around 90 percent of cost to make the investment economically attractive.

While the study and its conclusions refer primarily to State incentives, a parallel with Federal tax incentives can be made. The study suggests that, on the Federal and State levels, available methods of analysis are not capable of determining with any degree



of certainty to what extent energy tax incentives stimulate investment in energy-saving equipment.

OAK RIDGE NATIONAL LABORATORY, NOVEMBER 1980

The study was intended to evaluate the results of the three policy options--buildings' energy performance standards, tax credits for investments, and taxes on fuel use--on energy consumption in commercial buildings. Through a simulation model, the study projects, to 2000, energy use under each policy option and compares cumulative energy use, capital, fuel, and total costs resulting from each alternative. The procedure followed simulated an energy use in 2000 associated with the Building Energy Performance Standards (BEPS) and design fuel taxes or credits which would result in the same energy use as in the BEPS case.

The principal result of the analysis suggests that a 15 percent fuel tax or a 40 percent investment tax credit would result in the same annual energy use in the year 2000 as in the BEPS case. Further, the fuel tax alternative reaches the energy use target in 2000 with the least capital and fuel costs of the three policy options. The study suggests that a very large tax credit would be required for energy conservation purposes, and that the Government might achieve comparable or superior results at a lower cost to Treasury by using other means.

However, the analysis is based on a simulation model--not on historical data--and the energy savings were assumed targets. While the study provides some insight on the role of energy tax incentives it does not answer the question of the tax credits' effectiveness.

U.S. DEPARTMENT OF ENERGY, JULY 1978

The study evaluates the energy effects of several tax measures associated with the 1978 National Energy Act under consideration by the Congress at that time. The tax measures examined included the tax credits for energy conservation and solar investment proposed in H.R. 5263. Specifically, these measures are (1) a 20-percent tax credit for the first \$2,000 of investment in residential conservation equipment; (2) a 30-percent tax credit for the first \$2,000, and a 20-percent credit for the next \$8,000 of investment in residential solar heating, water heating, and cooling equipment; (3) a 15 percent credit for purchase of commercial conservation equipment, and a (4) 10-percent credit for investment in solar heating, water heating, and cooling equipment for commercial buildings. Variations of these provisions eventually were incorporated into the Energy Tax Act of 1978. Other measures included: (1) petroleum and natural gas user taxes and industrial investment tax credits both as proposed by the President in the 1977 National Energy Plan (NEP) and as later passed by the Senate and (2) the crude oil equalization taxes both as proposed in the NEP and as finally approved by the House of Representatives. The study projects

the energy-savings likely to be achieved in 1985 for various combinations of these measures. The analysis is based on 1977-78 data.

Several models were employed to make these projections. DOE's Residential and Commercial Energy Use Model and the Solar Market Development Model were used to project fuel substitution from oil and gas to other fuels. The Energy and Environmental Analysis Inc./Industrial Model was used to analyze the effects of oil and gas user taxes on industrial fuel consumption, and the Project Independence Evaluation System provided the framework for integrating the supply and demand impacts of the measures analyzed. The models were altered somewhat to simulate the various tax measures. Energy conservation and solar tax credits were simulated under two assumptions: with and without electric utility coal capacity construction limits based on planned capacity additions. The study emphasized the mid-term price forecast contained in DOE's 1988 Annual Report to Congress.

According to the study, the residential and commercial conservation and solar tax measures would reduce fossil fuel use by 0.7 quads in 1985 (primarily oil and coal consumption). Most of the savings would be in the residential sector. User taxes and industrial investment tax credits would encourage switching to coal, increase coal consumption, and decrease consumption of oil and gas as expected.

The results of this study indicate that energy savings would accrue as a result of energy tax incentives. However, the projections are based on simulations, and remain unproven.

CHARLES RIVER ASSOCIATES DRAFT FINAL  
SCHEDULED FOR COMPLETION ON FEBRUARY 15, 1982

This study is a followup on the author's 1981 work on tax credits for residential energy conservation equipment.

According to DOE officials, the work is designed to revise previous findings. The ongoing work should provide revised estimates of energy savings and cost to Treasury of the tax credits for residential conservation equipment. The authors will analyze the tax credits' effects under various different assumptions.

BROOKHAVEN NATIONAL LABORATORIES DRAFT REPORT  
SCHEDULED FOR COMPLETION ON MARCH 31, 1982

The purpose of this study is to quantify the energy savings which will result from business tax credits for investment in conservation and alternative energy equipment. The study will examine most of the business tax incentives and credits contained in the Energy Tax Act of 1978 and the Crude Oil Windfall Profit Tax Act of 1980. Specifically, it will include tax credits for: alternative energy property; solar and wind property; waste heat

recovery equipment; waste recycling equipment; and shale oil, ocean thermal, small-scale hydroelectric, and cogeneration equipment.

The approach consists of a cost benefit analysis, where the cost of the alternative energy equipment is compared with the energy savings from the equipment. Engineering and econometric models will be used to generate cost data and economic parameters for the cost benefit analyses. This will supplement information generated by Brookhaven in past efforts and data from various offices within DOE.

OAK RIDGE NATIONAL LABORATORY  
SCHEDULED FOR COMPLETION BY MID 1982

The purpose of this study is to analyze the historical effects of energy tax credits for residential conservation. To this end, Oak Ridge will analyze individual income tax data on a State-by-State basis for the 1978 tax year, by comprising 150,000 tax returns. The analysis will seek to determine how many individuals did or did not claim conservation credits and what factors, such as geographic location, temperature, income level, etc., influenced the decision whether to invest in energy conservation equipment. Oak Ridge plans to use the information generated to determine the energy savings from these tax incentives.

The standard statistical methods of regression analysis and correlations will be employed to establish the relationships between the decision to invest in conservation, as reflected in credit claims, and the factors influencing this decision.

CONGRESSIONAL RESEARCH SERVICE  
ESTIMATED ISSUE DATE, LATE FEBRUARY 1982

This study is designed to evaluate the energy, distributional, and allocation effects of Federal energy tax credits for conservation in the residential sector. The energy effects refer to the extent to which tax credits promote residential conservation energy investments. The analysis of distributional effects should provide information about the income groups which benefit most from the existing tax credits. Finally, the allocation analysis will attempt to determine how efficiently the credits are in allocating resources in the economy. The study employs statistical techniques. Tentative conclusions have been reached but the final report will not be ready until late February 1982.

SOLAR ENERGY RESEARCH INSTITUTE (SERI)  
SCHEDULED FOR COMPLETION IN THE FALL OF 1982

This study will examine the tax credits for residential solar hot water heaters. In evaluating effectiveness, the study will consider both State and Federal tax credits for all 50 States. Like several other studies, this work will employ statistical regression analysis. Among the variables considered in the

regression equation are: household's income level, population, degree of urbanization, energy prices, and installation cost. The analysis will attempt to determine the effect that tax credits have on energy investment decisions relative to other factors influencing decisions.

A SERI official indicated that this work was originally scheduled for the fall of 1981, but that data deficiencies inhibited further progress. According to this official, SERI requested IRS to provide disaggregated data on tax credit claims by State, but this effort has been delayed. Apparently, the available IRS Statistics of Income data are not appropriate for evaluating the tax incentives for residential solar water heaters.

The study is scheduled for completion by the fall of 1982, but this will depend on DOE's funding availability.

HIGHLIGHTS OF THE INTERNAL REVENUESERVICE'S ENERGY TAX CREDIT DATA

The Internal Revenue Service's (IRS') Statistics of Income provide data on residential and business energy investments and tax credits for 1978 and 1979. 1/ Currently, residential data are available by investment type (i.e., energy conservation and renewable energy sources) for both of these years, and by region and specific energy property (i.e., insulation, storm windows/doors, solar, geothermal, and wind) only for 1978. Business energy tax credit data is only available in aggregate form. (See tables 1, 2, and 3.)

The data show a substantial increase in the number of income tax returns containing claims for the energy tax credits, energy expenditures and, consequently, the amount of credit claimed in 1979 compared to 1978. 2/ In the residential sector, the largest increase was in renewable energy expenditures, which went up by 145-percent. However, in both years, energy investments in this sector have been largely concentrated in conservation devices. In 1979, for example, expenditures in conservation amounted to \$3.3 billion and the tax credits claimed accounted for 91 percent of the total of \$477 million claimed in this sector. (See table 2.) In the business sector, the number of taxpayers claiming the energy tax credit increased by 200 percent and the tax credit increased by 40 percent between 1978 and 1979.

The following more detailed data on residential energy investment were available for 1978 only:

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1/Energy investments that qualify for Federal tax credits as provided for in existing legislation.

2/The 1978 residential energy tax credit data cover the period April 20, 1977, through December 31, 1978. To compare the energy investment made between 1978 and 1979, we standardized the 1978 data on a 12-month basis and excluded 1977 investments. By doing this, we established a "lower limit" on the energy investments which could have actually occurred in 1978. Consequently, the estimates on the percentage increase in investment activity shown in table 2 should be considered "upper limits."

The actual 1978 investment could have been higher than that shown in table 2 because perhaps most of the investment took place in 1978 since legislation enacting the credits was passed that year. Taxpayers who invested after April 1977 and claimed a credit in 1978 invested without knowing that they were eligible for a credit. However, there is no information available regarding the actual investments in 1978 versus 1977.

- Insulation and storm windows/doors each accounted for 42 percent of the total energy expenditures in this year.
- Solar energy accounted for 96 percent of the total residential expenditures in renewable energy sources.
- Geothermal expenditures were about \$3 million and wind energy \$1.6 million.

The North Central States, Northeast, and South had the largest expenditures in residential energy property (mostly conservation devices). Of these, the highest was the Northeast, with expenditures of \$1.4 billion, even though the number of returns in this region was lower than in the North Central region. The State reporting the highest energy expenditures was New York (\$527 million). However, the West was notably high in renewable energy expenditures (\$61 million). The States with the largest expenditures in renewable energy were California, Hawaii, Washington, and North Carolina. California was the largest, with expenditures of \$18.3 million. Hawaii was the second largest, with \$15.15 million. Table 3 shows 1978 data on energy expenditures and amount of credit claimed by region.

Table 1

Residential and Business  
Energy Tax Credit Data

	<u>Residential</u>			<u>Business</u>		
	<u>1979</u>	<u>1978</u>	<u>Total 1979-78</u>	<u>1979</u>	<u>1978</u>	<u>Total 1979-78</u>
	(note a)	(note b)		(note a)		Total 1979-78
Income tax returns claiming energy tax credits (million)	4.875	5.969	10.844	4.516	1.515	6.031
Energy expenditures (billion)	\$ 3.484	\$ 4.225	\$ 7.709	NA	NA	-
Tax credit claimed (billion) (note c)	\$ 0.477	\$ 0.591	\$ 1.068	\$ 0.189	\$ 0.135	\$ 0.324

a/Preliminary data.

b/Includes expenditures made from April to December 1977.

c/Credit before limitation.

NA: Data not available.

Source: Internal Revenue Service, Statistics of Income; U.S. Department of Energy, Conservation and Renewable Energy.

Table 2

Residential Energy Tax Credit  
Data by Investment Type

	<u>Energy conservation</u>			<u>Renewable energy sources</u>			<u>Total energy investment</u>		
	<u>1979</u>	<u>1978</u>	<u>% Change</u>	<u>1979</u>	<u>1978</u>	<u>% Change</u>	<u>1979</u>	<u>1978</u>	<u>% Change</u>
	(note a)	(note b)	(note c)	(note a)	(note b)	(note c)	(note a)	(note b)	(note c)
Returns claiming energy tax credits (millions)	4.8	3.54	36	0.075	0.041	83	4.875	3.581	40
Expenditures (billion)	\$ 3.300	\$ 2.460	\$ 34	\$0.184	\$0.075	\$145	\$ 3.484	\$ 2.535	\$ 37
Tax credit claimed (billion) (note d)	\$ 0.435	\$ 0.335	\$ 30	\$0.042	\$0.019	\$121	\$ 0.477	\$ 0.354	\$ 35

a/Preliminary data.

b/Standardized on a 12-month basis because the data available for 1978 include information from April 1977 to December 1978. The figures may underestimate the actual energy investment activity which took place in 1978. See app. III, p. 17 for a discussion of these figures.

c/The percentages are upper limit estimates. They do not represent the actual change between 1978 and 1979. (See app. III, p. 17.)

d/Credit before limitation.

Source: Based on information from the Internal Revenue Service, Statistics of Income; U.S. Department of Energy, Conservation and Renewable Energy.



Table 3  
Returns with Residential Energy Expenditures and  
Credits Claimed, by Regions—1978

Region	Total			Energy Conservation			Renewable Energy		
	No. returns	Expenditures (thousands)	Credit claimed (before limitations) (thousands)	No. returns	Expenditures (thousands)	Credit claimed (before limitations) (thousands)	No. returns	Expenditures (thousands)	Credit claimed (before limitations) (thousands)
Northeast	1,686,201	\$ 1,415,847	\$ 190,560	1,682,593	\$ 1,396,623	\$ 184,553	8,372	\$ 19,224	\$ 5,007
New England	451,692	345,417	46,486	449,650	334,959	43,963	3,915	10,458	2,522
Middle Atlantic	1,234,509	1,070,430	144,074	1,232,943	1,061,664	140,590	4,457	8,766	2,485
North Central	2,115,573	1,344,660	187,964	2,111,122	1,333,326	185,037	6,935	11,334	3,429
East North Central	1,456,770	949,449	132,481	1,453,507	940,150	130,052	3,771	9,299	2,931
West North Central	658,803	395,211	55,483	657,615	393,176	54,985	3,164	2,035	498
South	1,535,177	1,013,476	144,083	1,520,290	980,003	135,189	26,279	33,473	8,893
South Atlantic	834,456	546,596	80,170	821,836	521,048	73,269	23,279	25,548	6,902
East South Central	319,179	198,746	26,696	318,407	195,190	25,819	919	3,556	875
West South Central	381,542	268,134	37,217	380,047	263,765	36,101	2,081	4,369	1,116
West	621,898	450,393	68,697	604,069	389,390	53,421	27,752	61,003	15,276
Mountain	270,455	183,847	27,147	267,960	168,080	23,302	7,036	15,767	3,844
Pacific	351,443	266,546	41,550	336,109	221,310	30,119	20,716	45,236	11,432
TOTAL U.S.	5,960,618	4,225,719	591,509	5,919,841	4,100,680	559,402	69,341	125,039	32,107

Source: Internal Revenue Service, Individual Returns/1978-State Data



Department of Energy  
Washington, D.C. 20585

JAN 26 1982

Mr. J. Dexter Peach  
Energy and Minerals Division  
United States General  
Accounting Office  
Washington, D.C. 20548

Dear Mr. Peach:

The Department of Energy appreciates the opportunity to review and comment on the GAO draft report entitled "The Federal Government Knows Little About the Effectiveness of the Energy Tax Incentives." The GAO recommends that Congress defer action on major legislated changes on tax incentives until more definitive information is available on their effectiveness.\* The report concludes that completed analyses provide no definitive answers on the effectiveness of energy tax credits, but that work in progress may provide a better base for judging the performance of these tax incentives. This conclusion is based upon GAO's review of completed and ongoing analyses of energy tax credits. The GAO draft report also says that DOE should establish firm deadlines for its ongoing analyses of this issue.

The Congress enacted a broad program of tax credits in 1978 and expanded them in 1980 with the awareness that tax subsidies would offer fewer opportunities for administrative control than a direct expenditure program. The differences between direct expenditure programs and tax credit programs have been previously documented in reports by the Congressional Budget Office and GAO. Enactment of the tax credits for conservation and renewables occurred with foreknowledge that evaluation of the results would be more difficult than for a program of direct expenditures. The simplified administration and more limited interference in private decisions from tax credits was accepted by Congress as a worthwhile benefit for giving up the broader opportunity for evaluation and accountability that would accompany a direct expenditure program.

Congress may wish to defer action on energy tax credits, but it is difficult to argue that this decision should await definitive conclusions from analyses of this issue. The effort to study the effectiveness of energy tax credits can provide only estimates and surmises.

Claimants of the credits are not required to show that they made their qualifying expenditures in response to the credits. The only requirement is that the expenditure be made. Therefore, no information is provided on how much investment in these items was induced by the tax incentive.

\*See GAO note 1, p. 25.

- 2 -

Some conservation investment would have occurred even without the credits. Therefore, only part of observed expenditures can be attributed to the available credit. Because other determinants of conservation investment (fuel costs, interest rates, public awareness) are also changing, identification of the portion attributable to tax credits requires estimation techniques.

It is true, as the GAO report states, that none of the tax credit studies has conclusively determined the effectiveness of the energy tax credits. We agree with GAO that analyses in progress will provide valuable information on the effectiveness of energy tax credits. However, the GAO report risks misleading the Congress by suggesting that definitive conclusions can be reached by additional analyses of this issue.

Three studies sponsored by DOE were not mentioned in the report. Two have been completed: "Analysis of the Impact of Federal Tax Incentives on Market Diffusion for Solar Thermal/WECS Technologies: 1980-1990" by Urban Systems Research and Engineering, Inc., and "The Cost of Federal Tax Credit Programs to Develop the Market for Industrial Solar and Wind Energy Techniques" by Arthur D. Little, Inc. Copies of the draft final reports are enclosed. In addition, the Solar Energy Research Institute is undertaking an analysis of the renewable energy tax credits. This study is scheduled for completion in the fall of 1982.

With regard to the deadlines for DOE's ongoing work on energy tax credits, a draft final report for the ongoing analyses with Charles River Associates is scheduled for February 15, 1982. The Brookhaven National Laboratory's draft final report is due March 31, 1982. Final reports are scheduled for completion one month after comments are received from DOE. The ongoing study of residential energy credits by Oak Ridge National Laboratory is scheduled for the middle of 1982, when additional tax return data is expected to be available from the Internal Revenue Service. DOE will transmit copies of the final reports to GAO when they are completed.

Thank you for the opportunity to comment on this draft report. Additional comments on the analysis and its presentation have been provided directly to members of the GAO staff. [See GAO note 2.]

Sincerely,

*William S. Heffelfinger*  
 William S. Heffelfinger  
 Assistant Secretary  
 Management and Administration

Enclosure

- GAO note 1: We did not pose this idea as a recommendation-- only as a suggestion. It was deleted from subsequent drafts of this report.
- GAO note 2: The enclosure to this letter, which is not included in this final report, contained technical comments which were considered in preparing the report.



ASSISTANT SECRETARY

DEPARTMENT OF THE TREASURY  
WASHINGTON, D.C. 20220

JAN 29 1982

Dear Mr. Anderson:

Enclosed are the Treasury Department's comments on the GAO draft report entitled "The Federal Government Knows Little About The Effectiveness of The Energy Tax Incentives."

The Treasury Department finds no basis for the GAO's recommendation that legislative changes in the energy tax credits be deferred pending the results of ongoing econometric studies.\* The decontrol of oil, completed in January, 1981, and the business investment incentives in the 1981 Economic Recovery Tax Act, in particular, the Accelerated Cost Recovery System, have removed barriers to investment in conservation and alternative energy technologies. These changes have removed the principal rationale for providing targeted tax incentives for qualifying energy capital. However, the GAO Report fails to address the basic issue of whether these incentives are still needed.

If the energy tax incentives are obsolete, and merely divert scarce capital to less productive uses, even a finding that they are "effective" in increasing qualified investments would not justify their continuance.

The draft GAO Report is also misleading in other respects. The enclosed comments provide details and suggest changes that should be incorporated in the final report.

Sincerely,

John E. Chapoton  
Assistant Secretary  
(Tax Policy)

Mr. William J. Anderson  
Director  
General Government Division  
U.S. General Accounting Office  
Washington, D.C. 20548

Enclosure

\*See GAO note 1, p. 28.

## Treasury Comments on GAO Report

The report asserts that "existing analyses of the effectiveness of tax incentives is limited and provide no definite answers." In the belief that further research will produce these answers, GAO recommends that Congress defer action on major legislative changes "until more definitive information is available on their effectiveness."

The GAO assessment of the studies does not justify their policy recommendations for several reasons. First, the GAO has failed to address the basic question of whether there is now any need to provide special tax credits for investments in conservation and alternative energy sources. At the time Congress enacted this legislation, price and allocation controls were in effect on both crude oil and natural gas and there was substantial political resistance to decontrol. Because of price controls, business firms and households had insufficient incentive to invest in energy-conserving or in alternative energy sources. Since the credits were enacted, oil prices have been decontrolled and the Administration's Accelerated Cost Recovery system, enacted as part of the 1981 Economic Recovery Tax Act, has removed tax disincentives to capital investment. In the changed environment, it is unclear why there need to be special tax incentives to encourage scarce capital to be diverted to qualifying energy investments and away from other productive uses. Put another way, if the original justification for these incentives no longer applies, legislative changes need not be deferred until good estimates of their effectiveness are available.

Second, it is unlikely that the studies referred by GAO will produce universally agreed conclusions within a reasonable time period. The econometric studies can only make reasonable inferences from the inadequate data available on what investments might have occurred absent the credits; they can not prove definitely one way or another if the credits were "effective". Thus, while the studies referred to by GAO are useful and provide a better basis for estimates made by analysts in the government, it is naive to expect that further study will produce a clear set of policy implications.

Finally, in a period of tight budgets, the burden of proof should be on advocates of special subsidy programs, not on advocates of repeal. It is bizarre to suggest that legislation providing special subsidy to an industry should be continued, pending a definitive finding that the subsidy is ineffective. Rather, GAO, as a watchdog of government waste, should question whether Congress might not consider repealing a subsidy for which its proponents have offered no proof of effectiveness.

-2-

Beyond these general comments on the conclusions, there are several inaccurate or misleading statements in the report that are worth correcting:

Page 2 The report notes three categories of incentives: tax credits, deductions, and deferrals of tax payments. "Deductions" are not in themselves an incentive if the deduction is for legitimate costs of business; the item should be corrected to read "deductions in excess of expenses incurred." In addition, the report should mention tax-exempt financing as another form of incentive.

Page 9 The issue is whether the energy tax incentives are "diverting resources to the desired activities efficiently", as stated in the report. Rather, the issue is whether resources should be diverted to these activities at all. Is there any reason to believe that markets allocate too few resources to these types of investment, relative to other uses of capital? [See GAO note 2.]

Page 13 The energy tax credits are not included in DOE's budget, as stated in the report. Rather, the energy tax credits and all other tax expenditures are listed by function in Special Analysis G of the Federal Budget, but not included in the budget ceilings of any agency. The failure to include tax expenditures in agency budgets, and the resulting absence of any incentive for agencies to trade off tax expenditures for direct spending programs aimed at similar objectives, is an important factor making tax expenditures difficult to control. [See GAO note 3.]

Pages 14-15 The report provides a misleading and incomplete description of Treasury estimating procedures. The Treasury analyst (not Treasury "official", as stated in the report) who spoke with GAO did not regard the estimates as "speculative". In most cases, the estimates were based on official DOE projections of either investment or additions to capacity; where DOE projections were unavailable, industry sources were used. The estimates were prepared in consultation with the Joint Tax Committee, and represent a consensus of both staffs. Rather than term the estimates as "speculative", one might say that estimates are based on the best available evidence in an area in which there is a great deal of uncertainty. [See GAO note 3.]

The revised estimates prepared for the 1983 Budget do take account of historical data and are based on projections made since the decontrol of oil and enactment of the Administration's tax and budget programs. The GAO Final Report should take note of these revisions.

- GAO note 1: We did not pose this idea as a recommendation-- only as a suggestion. It was deleted from subsequent drafts of this report.
- GAO note 2: Page references in this appendix which referred to the draft report were changed to reflect their location in this final report.
- GAO note 3: These comments relate to matters discussed in the draft report but omitted from the final report.



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