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Study of State Energy Conservation Program:

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1979 Energy Savings Indicators

Published June 1980

Prepared for:
U.S. Department of Energy
Assistant Secretary for Conservation
and Solar Energy
Office of State and Local Assistance Programs
Under Contract No. DE-AC01-80CS62122

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ABSTRACT

This study reviewed 1979 energy savings reports provided by states for conservation measures in four major categories of State Energy Conservation Program services. The major categories of services reviewed were:

- 1) Industrial, Commercial, and Institutional
- 2) Residential
- 3) Thermal and Lighting
- 4) Transportation

Conservation measures in these categories constitute a major portion of the total estimated 1980 savings for the State Energy Conservation Program. This study only addressed measures in these categories for which useable documentation had been submitted by states.

Based on a review of measures supported by available documentation, the study estimates that energy savings associated with the conservation measures reviewed were 108 TBtu's for the calendar year 1979. These estimated energy savings for 1979 were converted into 540 million dollars for 1979 and 2.8 billion dollars over the projected life of the conservation measures.

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I. INTRODUCTION

A. Purpose

The project described in the following pages was completed at the request of the U.S. Department of Energy and is designed to provide a quick response study of the amount and value of energy savings associated with some of the more readily quantifiable SECP grant program efforts during the calendar year 1979.

The scope of the project did not include an audit or validation of energy savings reported by states, but was based instead on analysis of data indicating the amount of services provided and the response to those services in terms of reduced energy consumption. These data, obtained from state and other sources, were used to develop estimates of 1979 energy savings.

The specific methods used to develop these estimates are summarized below and again, in more detail, in the later sections of this report.

B. Methods

In general, estimates of energy savings resulting from the SECP grants were developed as follows:

- (1) All service measures funded by the SECP program were organized into the following four categories, plus an "Other" category.
 - a) Industry, Commercial and Public Institutions;
 - b) Residential;
 - c) Thermal and Lighting Standards in all categories;
 - d) Transportation.

- (2) The state-provided 1979 energy savings reports were reviewed and summarized by the four above categories. The four categories were selected for analysis as they constituted over 75 percent of total 1979 reported savings.
- (3) For the types of service measures in each major category, "units of service" were identified. In the Residential area, for example, units of service might consist of homes receiving Class A audits.
- (4) Annual savings reports provided by all states covering the 1979 calendar year were reviewed to identify, where documented, the total units of service provided nationally by each SECP program measure. If savings reports did not include data on units of service, and estimates could not be obtained, the savings claimed for such state measures were disregarded for purposes of this study.
- (5) Best available state and national evaluation studies were reviewed to estimate the average savings brought about by an individual unit of service (i.e., an index of Btu's saved per unit of service).
- (6) Totals of units of service were multiplied by the average savings per unit of service to derive Btu's saved as a result of individual measures. Individual measure savings were summed to generate a savings total by the categories, as shown in Section II.
- (7) The dollar value of the energy saved was obtained using a national (weighted) average price per Btu for energy consumed in each major category of program services, and extrapolating that figure over the estimated average life of the reported energy saving actions (assuming actions were initiated in 1979).

This study attempted to distinguish between three categories of savings. These three categories include 1) energy savings caused by SECP efforts, 2) energy savings brought about by a combination of SECP efforts and other factors (e.g., where a person is motivated to reduce energy consumption by higher prices, and an SECP program measure provides the vehicle, or service, by which reduced consumption is achieved); and 3) energy savings brought about exclusively by other factors (e.g., prices, federal regulation, etc.). Examples of these different

categories are presented in Appendix I. The present study attempts to include only the energy savings which are directly related to the SECP services. In cases where SECP has interacted with other factors, the estimation methods have attempted to identify that portion of savings attributable to SECP.

C. Limitations of the Study

The results presented in the following pages represent a limited quick response effort to estimate energy savings occurring in the 1979 calendar year and should not be construed as a validation of State reported data. Such a validation study is now being conducted by the Department of Energy and should be completed toward the end of this fiscal year. It was understood that time and available resources would not allow contact with state energy offices to obtain additional detail on the documentation (e.g., data sources, types of surveys) of their reported savings.

As a result, the study is dependent on data available from state documentation, as well as reasonableness checks using other studies. When appropriate, data found in state documentation have been adjusted utilizing alternate data sources. For example, where a state(s) had undertaken a reliable survey to measure SECP results, such results were applied generally to other states whose savings estimates for the same measure were less well documented. Such efforts have certainly improved the accuracy of the data, although the exact level of accuracy can still not be defined.

A major issue faced in this report relates to the attribution of energy savings to SECP as opposed to other factors, such as rising prices, government regulations, and public spiritedness. In many instances, methodologies used by states to measure energy

savings did not attempt to identify the discrete savings attributable to SECP. Resources and time constraints did not allow for surveys to determine such discrete savings. Where appropriate, an attempt was made to include in the savings estimates only those savings attributable to SECP based on "attribution factors" available in other studies.

Finally, there are certain energy savings which are nearly certain to have occurred as a result of SECP efforts which, because of inadequate documentation, could not be included or presented in this report. Many states did not make budget commitments to evaluation and such states reported energy savings in 1979 which in some cases were not well documented. For example, the majority of energy savings reported for 1979 by states were not accompanied by data on units of service -- e.g., number of homes receiving a Class B audit. In such cases, it was not possible to include savings estimates reported by such states in the summary estimates. For certain measures this lack of documentation made it very difficult to estimate the energy savings associated with an entire measure. Therefore, such measures were excluded from this review. A list of measures not reviewed is presented at the end of each section of this report.

Further limitations of this study are described in Appendix II, and the remaining appendices discuss additional details of the study methodology which are not practical to include in the main body of the report.

D. Results

The results of this study are presented in table and narrative form in Sections II through VI of this report. Section II presents a national summary of 1979 energy savings by the four

service categories covered by the study. In addition to the 1979 energy savings, an estimate of the associated dollar value of the energy (Btu) savings brought about by the SECP program is presented.

Sections III through VI, in turn, address each service category in detail. Tables in these sections present the documented units of service, the index of savings per unit of service, estimates of total 1979 energy savings, and the dollar value of the energy saving actions taken.

Following each breakdown table, a narrative description of the units of service and indices used to estimate total energy savings, as well as a summary of how the estimates of energy and dollar savings were obtained, is presented.

II. SUMMARY TABLE

OF

ESTIMATED SECP ENERGY SAVINGS
FOR ALL CATEGORIES STUDIED

TABLE II: SUMMARY OF ESTIMATED SAVINGS

Category	Energy Savings (TBtu's)	Dollar Value Of 1979 Energy Savings ^{1/}	Dollar Value Of Savings Over Estimated Life Of Measures ^{2/} (Discounted at 10%)
INDUSTRIAL, COMMERCIAL, AND INSTITUTIONAL	3.43	\$ 12,832,500	\$ 121,926,714
RESIDENTIAL	1.05	3,150,000	29,929,410
THERMAL EFFICIENCY STANDARDS	48.83	159,918,250	2,066,943,381
TRANSPORTATION	54.36	364,212,000	597,175,854
TOTAL	107.67	540,112,750	2,315,975,359

^{1/} Based on a weighted average price of fuels consumed by the following sectors in 1979: Industrial - \$0.00000437 per Btu; Commercial and Institutional - \$0.00000355 per Btu; Residential - \$0.000003 per Btu; Thermal Efficiency - \$0.000003275 per Btu; and Transportation - \$0.0000067 per Btu (see Appendix V for explanation).

^{2/} See Tables III, IV, V, and VI for more detail on calculation of numbers in this column.

III. 1979 ESTIMATED SECP ENERGY SAVINGS
IN THE
INDUSTRIAL, COMMERCIAL AND INSTITUTIONAL CATEGORY

TABLE III: SUMMARY OF ESTIMATED SAVINGS - INDUSTRIAL, COMMERCIAL, AND INSTITUTIONAL

Measure	Units of Service	Number of States Reporting Units of Service	Index (Btu's Saved Per Unit of Service)	Energy Savings (TBtu's)	Dollar Value of 1979 Energy Savings ^{5/}	Dollar Value of Savings Over Estimated Life of Measure ^{6/} (Discounted at 10%)
CLASS A AUDITS						
INDUSTRIAL	1,483	8	346.0×10^6	$0.48^{1/}$	2,097,600	19,930,137
COMMERCIAL	2,265	6	$\frac{2/}{}$	0.37	1,313,500	12,480,089
INSTITUTIONAL						
SCHOOLS AND GOVERNMENT BUILDINGS	1,108	8	52.0×10^6	$0.03^{1/}$	106,500	1,011,899
HOSPITALS & HEALTH CARE FACILITIES	32	4	$\frac{3/}{}$	$0.05^{1/}$	177,500	1,686,498
CLASS B AUDITS						
INSTITUTIONAL	5,000	1	33.0×10^6	0.16	368,000	5,396,795
CLASS C AUDITS						
COMMERCIAL	32,400	3	46.0×10^6	1.49	5,289,500	50,257,655
WORKSHOPS						
INDUSTRIAL	10,414	13	$\frac{4/}{}$	$0.32^{1/}$	1,398,400	13,286,758
COMMERCIAL	5,726	5	95.0×10^6	$0.47^{1/}$	1,658,500	15,853,085

TABLE III: SUMMARY OF ESTIMATED SAVINGS - INDUSTRIAL, COMMERCIAL, AND INSTITUTIONAL

Measure	Units of Service	Number of States Reporting Units of Service	Index (Btu's Saved Per Unit of Service)	Energy Savings (TBtu's)	Dollar Value of 1979 Energy Savings ^{5/}	Dollar Value of Savings Over Estimated Life of Measure ^{6/} (Discounted at 10%)
WORKSHOPS (CONTINUED)						
INSTITUTIONAL						
SCHOOLS & GOVERNMENT BUILDINGS	3,478	3	17.0 X 10 ⁶	0.06	213,000	2,023,798
TOTALS				3.43	12,832,500	121,926,714

^{1/} The index was applied to all units of service, but resulting savings were reduced by the time factor which the states reported for program measures which were not in effect for all of 1979.

^{2/} A savings index of 0.699×10^9 Btu's per audit was applied for all states except South Carolina, for which an index of 4.9×10^6 Btu's was applied.

^{3/} State-specific indices were applied for the four states in this category; see text for details.

^{4/} A savings index of 39.5×10^6 Btu's per participating firm was applied for all states except Florida, for which an index of 24×10^6 Btu's per participating firm was applied.

^{5/} Based on a weighted average price of fuels consumed by the Industrial sector in 1979 of \$0.00000437 per Btu and by the Commercial and Institutional sectors of \$0.00000355 per Btu. (See Appendix V for explanation.)

^{6/} Assumes 15-year life. Discounted at 10% once each period (year) for 15 periods. Assumes that real price of energy will increase at 2.35% per year.

III. 1979 ESTIMATED SECP ENERGY SAVINGS IN THE INDUSTRIAL,
COMMERCIAL AND INSTITUTIONAL CATEGORY

State energy conservation programs have recognized the important role which the industrial, commercial, and institutional sectors play in the nation's demand for energy. Total industrial and commercial energy consumption represents approximately forty percent of the total national consumption. All but one state and two territories claimed energy savings for SECP measures addressing this sector.

Conservation measures in this sector are directed at establishments which vary greatly in size as well as in type of energy use. This diversity creates problems for evaluating these state energy conservation measures. In their 1979 reports to the Department of Energy, states did not uniformly specify the type and size of firms which their program measures influenced. Without this information, accurate estimates of energy savings nationwide are difficult. In some cases, industrial and commercial consumption data are not readily available as some firms consider energy consumption data to be proprietary information, and are reluctant to divulge such data.

The need to verify that energy savings are attributable to SECP measures is particularly important in this sector. Firms are generally quite sensitive to increases in energy costs. This concern is particularly acute for those businesses for which energy bills represent a large portion of their total operating costs. Because firms often keep complete records of energy consumption, they are motivated to institute and to evaluate their own conservation efforts independently of SECP.

In addition to the problem of attribution, energy conservation in industry is properly a question of energy efficiency. Increases in the product output associated with a successful enterprise can require increases in energy consumption. However, energy consumption per unit of output could remain unchanged or even fall as a result of the efficiency of energy use in the production process. In such a case, a precedent does exist for a state, to claim energy savings based on the difference between what consumption would have been at current output with the previous period's efficiency, and actual current consumption. The Indiana energy office has explicitly addressed the issue of energy efficiency in its energy savings reports.

In light of both the strong incentives for conservation in the industrial, commercial, and institutional sector, and the difficulty in isolating increases in energy efficiency, we were particularly conservative in assessing SECP energy savings in this sector for 1979. Industrial savings indicators for some states were not included because the states' documentation did not tie savings to specific services rendered under the states' SECP measures. In general, energy savings were included only when supported by documentation which described and quantified the service which the SECP measure provided the firm.

Our assessment of savings in the sector focused on the following program measures in the industrial, commercial, and institutional sector because the state documentation reported for these measures included quantifiable units of service.

- o Class A Audits--consist of on-site inspections by energy auditors of a firm's facilities. Auditors tailor their recommendations to the firm's energy requirements.

- o Class B Audits--permit an energy office to make individualized recommendations for conservation without visiting a facility. Managers of a business or institution complete questionnaires about their facility's energy requirements and return them to the energy office for evaluation. The auditor, often with the assistance of a computer, uses the information the managers have provided on the questionnaire in developing appropriate recommendations.
- o Class C Audits -- consist of workbooks which instruct a manager to inspect his facility for potential means by which to conserve energy.
- o Workshops -- usually consist of one- or two-day energy conservation classes for representatives of businesses or institutions. Workshops can be broad, treating general energy management, or specific, treating boiler efficiency or specific industrial processes.

A. Measure: Class A Audits

Class A audits are the most comprehensive form of SECP assistance available to a firm or institution. Because energy use varies greatly between the industrial, commercial, and institutional categories, Class A audits are discussed below in three separate sections. Even within these three categories, there is great variation in the size and type of facility audited. The states rarely distinguish among these recipients.

1. Class A Audits - Industrial

a. Units of Service

Fourteen states claimed savings in 1979 as a result of Class A industrial audit programs. Of these, eight states included information about the number of audits performed. These programs ranged in size from three audits conducted in Alabama to 425 in Tennessee. The documentation included a total of 1,483 Class A industrial audits, or units of service, completed nationally.

b. Index

The index, or average savings in Btu's per audit, varies considerably from program to program. This variation may reflect the diversity in size and energy use of the recipients, and the differences in scope of the audit programs.

The program with the most reliable documentation of energy savings associated with Class A audits is the Tennessee Valley Authority (TVA) audit program under the auspices of the Tennessee Energy Authority. TVA reported savings of 2.4×10^9 Btu's per audit recipient. The TVA has conducted energy audits of its commercial and industrial customers for several years and has documented its savings using records of the number and location of audits and the energy savings which followed the audits. Because TVA is a major energy supplier in its region, it is in a good position to verify the savings resulting from audits. TVA did not appear to have addressed the attribution issue by comparing energy use by audit recipients to energy use by similar firms which did not receive audits. One national EES evaluation, however, did conduct such a study.^{1/} A review of these findings indicates that, for small businesses, 14.4 percent of energy saving actions could be attributed to the conservation program. Therefore, the product of the TVA savings index and 14.4 percent was used to obtain an index of 0.346×10^9 Btu's per completed Class A audit. Given that TVA analyzed actual utility records, using the attribution-adjusted, TVA-based savings per audit as an index for industrial Class A audits appears unlikely to overstate the savings for this measure.

^{1/} Evaluation Summary, "Energy Extension Service Pilot Program Evaluation Report: The First Year," September 1979, DOE/CS/2671-2 (see Appendix III for details).

2. Class A Audits - Commercial

a. Units of Service

Ten states reported savings in 1979 for Class A commercial audit programs. Of these, six states documented the number of audits performed. The number of audits conducted by these programs varied from a low of one audit in Missouri, to a high of 1,752 audits in South Carolina. The documentation includes 2,265 audits, or units of service, performed nationally.

b. Index

The average savings per audit reported for the two largest programs (Michigan and South Carolina), vary by a factor of twenty. Michigan's evaluation strategy employed a control group to verify savings. Michigan surveyed firms which had received audits, and firms which had not received SECP help but in some cases had taken conservation measures for other reasons. This strategy addressed directly the question of attributing savings to SECP measures. Michigan computed an average savings of 0.699×10^9 Btu's per audit.

Michigan's reported savings per audit is well documented for firms using more than one fuel type. For this reason, Michigan's "index" has been applied to its 500 audits and the remaining states' thirteen audits. This "index" was not deemed appropriate for South Carolina.

In South Carolina, the public utilities conducted Class A commercial audits in 1977 and 1978. The average savings per audit for this program was 34.0×10^6 Btu's per audit based on an analysis of utility records, roughly five percent of Michigan's

figure. Adjusted for attribution, using the results of the EES evaluation, South Carolina had a savings rate of 4.9×10^6 Btu's per audit. South Carolina reported all savings in terms of kilowatt hours, implying that all savings were due to conservation of electricity only. Therefore, it is not unreasonable that South Carolina's audit program should yield lower savings than Michigan's audit program. The attribution-adjusted savings figure was included for the 1,752 audits in South Carolina.

3. Class A Audits - Institutional

There are two distinct groups within the category of institutional facilities. Hospitals and health care facilities have energy intensive processes and equipment which set them apart from schools and government office buildings. Due to their different energy requirements, these two groups warrant individual consideration.

a. Class A Audits - Schools and Government Office Buildings

1) Units of Service

Eleven states claim savings for Class A schools and government office building programs. Eight states document units of service for these programs. The scope of these programs ranges from lows of five audits in Missouri and eight audits in South Carolina, to highs of 284 audits in Tennessee and 547 audits in Texas. The documentation available indicated a total units of service provided of 1,108 Class A audits.

2) Index

Average savings per audit ranged from a low of 0.34×10^9 Btu's per audit to a high of 11.0×10^9 Btu's per audit. Georgia and Texas provided the best documentation for Class A institutional audits. Both states surveyed recipients of audits to verify savings. Texas reported savings of 0.34×10^9 Btu's per audit. Georgia based its reported savings of 1.7×10^9 Btu's per audit on utility records. Using the EES evaluation data cited above, conservation measures in public institutions appeared to account for 5.1 percent of total energy savings. The savings indices adjusted for attribution were then 86.7×10^6 Btu's per audit for Georgia and 17.3×10^6 Btu's per audit for Texas. The index used for Class A commercial audits was an average of the adjusted savings figures for Georgia and Texas: 52.0×10^6 Btu's per audit.

b. Class A Audits - Hospitals and Health Care Facilities1) Units of Service

Six states reported savings for Class A hospitals and health care audit programs. Of these, four states documented the units of service (i.e., the number of audits performed) and all appear to have a relatively small scope. American Samoa audited one hospital, South Carolina two, Nevada four, and North Carolina twenty-five, for a total of 32 units of service.

2) Index

The savings reported for these programs range from a low of 5×10^6 Btu's per audit for American Samoa to a high of .49 TBtu's

per audit for South Carolina. No single index was used because the savings reports provided by the four states appeared well documented. American Samoa's audit addressed only lighting efficiency. Since American Samoa documented each bulb removed and the associated energy savings, energy savings were included as reported.

North Carolina, South Carolina, and Nevada based their savings reports on utility records. However, none of the states appeared to have considered attribution. In order to ensure conservative estimates, steps were taken to adjust for attribution. The results of the EES study, indicating that 5.1 percent of savings is attributable to program measures, were used to adjust the reported savings for these three states. The sum of the adjusted savings for these states has been included.

B. Measure: Class B Audits

Class B audits were available in the commercial and institutional sectors.

1) Class B Audits - Commercial

a. Units of Service

Three states claimed savings for three Class B commercial audit programs. Of these, two states documented the number of audits performed for a total of 439 units of service.

b. Index

No exemplary evaluation studies which could serve as a general index were available. Due to insufficient documentation, no reliable index could be applied to this measure.

2) Class B Audits - Institutional

a. Units of Service

Two states reported savings for Class B institutional audits. However, only one state, Ohio, reported 5,000 Class B audits conducted for the state's public schools.

b. Index

Ohio recorded consumption data, compliance rates, and savings rates for conservation recommendations for a two-year period for a sample of 282 schools. The state extrapolated from the sample to the entire school system. Again, the results of the EES evaluation study were utilized and an estimate of 33.0×10^6 Btu's per audit was identified for this program.

C. Measure: Class C Audits - Commercial

Class C audits were provided in the commercial sector.

1. Units of Service

Seven states report savings for Class C commercial audits. Of these, three states report units of service. The unit of service was defined to be the number of Class C workbooks which the state energy office distributed. The scope of these programs ranged from a low in one state of 500 workbooks distributed to a high of 25,000 workbooks distributed. The total units of service reported were 32,400 workbooks distributed.

a. Index

Class A audits are the most thorough type of assistance which an energy office can give to a firm. Therefore, it was assumed that the savings resulting from a Class C commercial workbook can be no greater than savings accruing to a Class A commercial audit. Using the index of 0.699×10^9 Btu's per Class A commercial audit, a ceiling was established for reasonable values of savings per workbook.

Three states cited surveys as the source of compliance and savings information. However, relatively little detail was available on the surveys. In the absence of specific information about the surveys, the index used was an average of the savings reported from the three surveys, adjusted for attribution using the EES 14.4 percent factor for small business.

	20 x 10 ⁶ Btu's per workbook
	36 x 10 ⁶ Btu's per workbook
	<u>81 x 10⁶ Btu's per workbook</u>
Total	$137 \times 10^6 \div 3 = 46 \times 10^6$ Btu's per workbook

Because this average figure includes adjustments for attribution, and because it is well below the ceiling set by Class A commercial audits, it is likely to be a conservative estimate of the savings resulting from Class C commercial audits.

D. Measure: Workshops

Because energy use varies considerably among workshop participants, workshops are discussed in three categories: industrial, commercial, and institutional.

1. Workshops - Industrial

a. Units of Service

The unit of service for a workshop is the number of firms represented by the participants of the workshop. Sixteen states report savings for industrial workshop programs. Of these, thirteen states document the number of firms participating in the workshops. These programs ranged in size from a low of twenty-three participating firms in Missouri to a high of 3,000 participating firms in Florida. The available documentation indicated the total units of service as 10,414 participating firms.

b. Index

Because Class A audits are the most effective type of assistance to a firm, the savings index for Class A industrial audits, 0.346×10^9 Btu's per audit, was considered to be a ceiling. It was assumed that savings from participating in an industrial workshop could be no greater than the savings resulting from a Class A industrial audit.

The reported savings per participating firm ranged from a low in Florida of 0.167×10^9 Btu's per participating firm to a high in Georgia of 54.0×10^9 Btu's per participating firm.

Five programs had savings rates less than the ceiling. Two of these programs based their estimates on surveys. The index used for this measure was the average of the two energy savings figures supported by surveys, adjusted for attribution using the 14.4 percent EES factor cited above: Louisiana, 43.0×10^6 Btu's per participating firm, and Iowa, 36.0×10^6 Btu's per participating firm. The average yielded an index 39.5×10^6 Btu's per participating firm.

Finally, one program consisted of a boiler efficiency workshop aimed at small boilers; i.e., those which consumed ten gallons of distillate per hour, and which operated only 1,200 hours per year. This program had a reported savings of 0.17×10^9 Btu's per participating firm and an attribution-adjusted savings of 24.0×10^6 Btu's per participating firm. Because this state directed its boiler efficiency workshops at small boilers not operating in heavy industry, and because its savings were less than the above index for industrial workshops, its savings were included at the adjusted rate of 24.0×10^6 Btu's per firm.

2. Workshops - Commercial

a. Units of Service

Ten states reported savings for commercial workshop programs. Of these, five states documented the number of firms participating in the workshops. The scope of the programs ranged from twenty-seven participating firms in one state, to 2,504 participating firms in another. The total reported units of service were 5,726 participating firms.

b. Index

It was assumed that savings from participation in a commercial workshop could be no greater than the savings from a Class A commercial audit. Therefore, the index used for Class A commercial audits, 0.699×10^9 Btu's per audit, were selected as a ceiling for the savings generated by workshops.

Reported workshop savings spanned a range from 0.18×10^9 Btu's per participating firm, for one state, to 19.0×10^9 Btu's per participating firm for another. Again, the results of the

EES evaluation were applied to adjust reports for attribution. The evaluation found that 14.4 percent of savings by commercial firms is attributable to the program measure. The adjusted savings rates for four of the six programs were less than the ceiling and therefore qualified as reasonable.

Only one of these four states based its report on survey information. This state, Texas, for its new commercial buildings workshop program had a reported savings of 0.66×10^9 Btu's per participating firm. The 14.4 percent attribution factor from the EES evaluation was, in turn, used to adjust the Texas savings data and the adjusted savings rate of 95.0×10^6 Btu's per participating firm was applied to all six states to determine the savings for this measure.

3. Workshops - Institutional

Institutional workshops addressed two categories of institutions: schools and government buildings, hospitals and health care facilities.

a. Workshops, Schools and Government Buildings

1) Units of Service

Six states reported savings for this category. Of these, three states reported the number of schools and government buildings represented by participants in the workshops. The smallest program reported eight participating institutions, the largest 2,610. One state reported that thirty-nine percent of its school districts participated. As 2,200 schools are located in the state, and it was reported that 39 percent of the schools,

were represented by participants in the program, 860 was used as the total units of service for this state. Therefore, total units of service were 3,478 schools and public buildings.

2) Index

Savings reports for this program were 1.9×10^9 , 0.52×10^9 , and 0.34×10^9 Btu's per participating institution.

Only Texas surveyed participants to verify a savings of 0.34×10^9 Btu's per participant. This figure was adjusted for attribution using the 5.1 percent factor cited in the EES evaluation to obtain an index of 17×10^6 Btu's per participating institution. This index was found to be below the reasonableness ceiling check set by the index for Class A schools and government buildings audits.

b. Workshops, Hospitals and Health Care Facilities

1) Units of Service

Four states reported savings for this category. Of these, two states reported the number of hospitals and health care facilities represented by participants in the workshops. The total units of service reported were 132 participants.

2) Index

No appropriate study was located and the documentation for this measure was inadequate to support the savings reports. Therefore, lacking an exemplary evaluation, no savings were included for this measure.

E. Measures Not Included in Units of Service Analysis

The following are general types of industrial, commercial, and institutional measures not included in the analysis in this section:

- o Waste recycling
- o Information clearinghouses
- o Tax credits for waste utilization
- o Thermostat set-backs
- o Technology sharing, non-workshops
- o Energy use regulations
- o Agricultural measures

IV. 1979 ESTIMATED SECP ENERGY SAVINGS

IN THE

RESIDENTIAL CATEGORY

TABLE IV: SUMMARY OF ESTIMATED SAVINGS - RESIDENTIAL

Measure	Units of Service	Number of States Reporting Units of Service	Index (3tu's x 10 ⁶ Saved Per Unit of Service)	Energy Savings (TBtu's)	Dollar Value of 1979 Energy Savings ^{2/}	Dollar Value of Savings Over Estimated Life of Measure ^{3/} (Discounted at 10%)
Class A Audits	112,015	5	<u>1/</u>	.16	480,000	4,560,672
Class B Audits	293,304	18	.9	.26	730,000	7,411,092
Class C Audits	1,251,691	12	.5	.63	1,890,000	17,957,646
Totals				<u>1.05</u>	<u>\$ 3,150,000</u>	<u>\$ 29,929,410</u>

^{1/} State-specific indices were used for four states. An average index was calculated from data provided by three of the states (the Class A Residential Audit Program for the fourth state was atypical) and applied in two additional state cases where:
 o energy savings for Class A, B, and C Audits had been aggregated; and
 o reported savings as a result of the program far exceeded the average.

^{2/} Based on weighted average price of fuels consumed by the residential sector in 1979: \$.000003 per Btu (see Appendix V for explanation).

^{3/} Assumes 15-year life. Discounted at 10% once each period (year) for 15 periods. Assumes that real price of energy will increase at 2.35% per year.

IV. 1979 ESTIMATED SECP ENERGY SAVINGS IN THE RESIDENTIAL CATEGORY

Residential energy conservation programs are primarily directed toward space conditioning, as the heating and cooling of single family residences accounts for the major energy demand per household. DOE estimates that 12 percent of U.S. energy consumption is used to heat and cool single family homes and that approximately 80 percent of these dwellings are insulated inadequately.

The consumer has the capability of significantly affecting the demand for space heating and cooling in a variety of ways. Installation of appropriate types and thicknesses of insulation, weatherstripping, caulking, adjusting thermostats, observing proper operating and maintenance procedures for HVAC systems and auxiliaries, and the addition of storm windows and doors are all examples of measures that can be taken in the home to conserve energy. Consequently, most states have adopted some programs in the residential sector.

The most common programs are Class A, B, and C residential audits, weatherization of homes, and public information programs directed toward residents. The following are brief descriptions of these programs:

- o Class A Residential Audits--consists of on-site visitations by analysts. The analyst or energy auditor surveys participants' homes and makes recommendations about steps the homeowners can take to reduce their consumption of energy. These audits are typically offered by utilities and are initiated when the consumer requests an audit.
- o Class B Residential Audits--are performed when the consumer completes and returns a questionnaire to the sponsoring utility or energy office. The responses are

keypunched and analyzed through the use of a computer program. The analysis which is then mailed to the household can contain not only recommended actions, but also the costs of taking the actions and the time required for actions to save an amount equivalent to their costs (or payback). The DOE sponsored "Project Conserve" is perhaps the most common example of a Class B residential audit program used by the states.

- o Class C Residential Audits--are a form of self-audit. Each household is provided a workbook which can be used to calculate the potential of a home or residence for energy savings. Some states assist consumers in making the required calculations; however, the usual role of the state energy office is to distribute the workbooks.
- o Weatherization of Homes--involves actual installation of insulation, caulking, and weatherstripping of low-income consumers' residences. Approximately 30 states have a weatherization program included in their SECP. The programs are principally administered by the states' welfare agencies or Community Action Agencies (CAP's). The energy office or SECP grantee organization typically assumes a program management or monitoring role in the weatherization program. Because SECP funds are not significantly involved, weatherization savings are excluded from this analysis. However, the states do report energy savings associated with weatherization as part of the SECP.
- o Public Information--efforts range from speeches urging homeowners (and renters) to conserve energy to televised workshops explaining a variety of energy saving technologies. Often the programs consist of the distribution of brochures covering much the same topics as Class C Audit workbooks, but to a lower level of detail. For reasons discussed in Section IV.D, savings provided by the states in connection with public information have been excluded from this analysis.

A. Measure: Class A Residential Audits

1. Units of Service

The unit of service for Class A Residential Audits is the number of homes upon which Class A Audits are performed in 1979. These figures were provided to DOE by the states in their 1979 SECP savings documentation.

The number of homes or units of service range from over 50,000 Class A residential audits in Tennessee to 3500 in Vermont.

2. Index

In 1979, five states provided the number of homes audited and the energy savings due to Class A Residential audits in their documentation reports. Individual state ratios or indices of Btu's of energy saved to homes audited (Class A) were calculated for Oklahoma, Vermont, Tennessee, Oregon and Rhode Island. Three of the states (Oklahoma, Vermont, and Oregon) evidenced a narrow range of indices, i.e., 14×10^6 to 25×10^6 Btu's. Given the small number of states involved, the narrow range of indices, and the nature of the program (the higher probability of compliance and energy savings due to the rigor of the audit approach and active participation of the homeowner) the indices for Oklahoma, Vermont, and Oregon were accepted. In addition, because the Energy Extension Service (EES) provides similar types of service (e.g., Class A, B, and C audits) to the SECP program, EES evaluation efforts were reviewed. The EES evaluation of the pilot program provided a means to adjust state energy savings estimates to account more accurately for attribution. The assumptions and calculations are discussed in Appendix IV. The result of the calculation was, then, applied to the state-specific indices for Oklahoma, Vermont and Oregon. This same factor was used throughout to adjust all national or state-specific indices (Btu's of energy saved per unit of service) for attribution in the cases of Class A, B, and C audits.

Rhode Island's program showed an appreciably higher ratio of Btu's of energy saved to homes audited (72×10^6 Btu's). However, the Class A Residential Audit Program in Rhode Island is

significantly different than in the other states. Energy auditors are affiliated with a non-profit corporation that also finances and installs insulation. Rhode Island's higher index was also accepted and the correction for attribution was applied to 72×10^6 Btu's.

In the case of one state, the 1979 documentation provided energy savings for Class A audits per unit of service that far exceeded the national average. Therefore, an average index of 19×10^6 Btu's was derived using the indices for Oklahoma, Vermont, and Oregon. Again, the attribution correction was applied to derive an adjusted index. Another state provided the units of service for Class A audits but aggregated Class A, B, and C audit energy savings. The same average index (19×10^6 Btu's) was applied and adjusted in this case.

B. Measure: Class B Residential Audits

1. Units of Service

The unit of service for Class B Residential Audits is the number of audit questionnaires analyzed. These figures were provided by the States in their 1979 documentation reports submitted to DOE.

The number of audit questionnaires analyzed by state energy offices, etc. ranged from over 50,000 in Pennsylvania to less than 1,000 in Washington, D.C., and Indiana. Eighteen states provided information on units of service provided in Class B Residential Audit programs and energy savings as a result of the program. States that only reported the number of Class B Residential audits distributed (versus distributed, returned and analyzed) were excluded from the analysis.

2. Index

To determine a single index or ratio of Btu's of energy saved per audit questionnaire analyzed, the following steps were undertaken:

- (1) The ratio of Btu's of reported 1979 energy savings per analyzed questionnaire was calculated for each of the 18 states.
- (2) The evaluation efforts discussed in the 1979 documentation were reviewed in all cases.
- (3) Indices for states with "reasonable" follow-up or survey efforts were accepted for purposes of deriving an average index of Btu's of energy saved per questionnaire. This index was computed to be 13×10^6 Btu's.
- (4) The 13×10^6 Btu's index was adjusted for attribution using the methodology described in Appendix IV.

C. Measure: Class C Residential Audits

1. Units of Service

The unit of service for Class C Residential Audits is the number of audit workbooks or manuals distributed during 1979. These figures were provided by the states in their 1979 SECP documentation submitted to the DOE.

The number of workbooks distributed ranges from 500,000 in New York to 2,600 in Missouri. Twelve states reported energy savings from a Class C audit measure with specific units of service (number of workbooks) reported.

2. Index

To determine a single index or ratio of Btu's of energy saved per workbook or manual distributed, the following steps were performed:

- (1) the ratio of Btu's of reported 1979 energy savings due to Class C Residential Audits to the number of workbooks distributed was calculated for each of the twelve states.
- (2) The evaluation efforts discussed in the 1979 documentation were reviewed.
- (3) Indices for states with "reasonable" follow-up or survey efforts were accepted for purposes of deriving an average index of Btu's of energy saved per questionnaire. This index was computed to be 75×10^6 Btu's and adjusted for attribution.

Review of the 1979 documentation indicated that four states (Vermont, New York, Missouri, and Utah) pursued "reasonable" evaluation efforts. These states used phone or written questionnaires to follow up and determine the results of the program. In the case of one state, non-respondent bias was reflected in the evaluation approach. Estimated savings reported by survey respondents had been projected across all workbook recipients. Using the information from two other states (Nevada and New York) which showed a non-respondent bias of approximately 7 percent, a correction was made for non-respondent bias and the adjusted index was used for the purpose of deriving an average.

D. Measure: Public Information -- Residential.

Energy savings provided by the states in the 1979 documentation for residential sector public information efforts (brochures, workshops, and other media efforts) were not considered in this analysis for the following reasons:

- o Few states provided data on units of service (or number of pamphlets or workshop attendees).
- o Reasonable evaluation efforts, i.e., follow-up surveys to determine the energy saved as a result of the program, were not available.
- o Total energy savings for public information -- residential sector were an insignificant amount of the total energy savings reported by the states for the sector.

E. Measures Not Included in Units of Service Analysis

The following measures in the Residential category were not included in the analysis in this section.

- o Weatherization
- o Workshops
- o Clearinghouses
- o Aerial Thermograms
- o Oil Burner Efficiency Programs

V. 1979 ESTIMATED SECP ENERGY SAVINGS

IN THE

THERMAL AND LIGHTING CATEGORY

TABLE V: SUMMARY OF ESTIMATED SAVINGS - THERMAL AND LIGHTING

Measure	Units of Service (Square Feet x 10 ⁶)	Number of States Reporting Units of Service	Index (Btu's x 10 ⁶ Saved Per Unit of Service)	Energy Savings (TBtu's)	Dollar Value of 1979 Energy Savings ^{1/}	Dollar Value of Savings Over Estimated Life of Measure ^{2/} (Discounted at 10%)
THERMAL EFFICIENCY STANDARDS	1199.9 ^{3/}	22	<u>4/</u>	48.8 ^{5/}	\$ 159,918,250	\$ 2,066,943,381

^{1/} Based on the average of: the weighted average price of fuels consumed by the residential sector (\$.000003 per Btu) and the weighted average price of fuels consumed by the commercial sector (\$.00000355 per Btu) in 1979 (see Appendix V for explanation).

^{2/} The average life of a building is assumed to be 33 years, as a reasonable average given the building types considered and the nation as a whole. Discounted at 10% once each period (year) for 33 periods. Assumes that real price of energy will increase at 2.35% per year.

^{3/} Units of service for thermal standards were adjusted based on appropriate factors of compliance. The factor for 1 year of implementation was .15 and for 2 years or more the factor was .70.

^{4/} The Index (Btu's saved per unit of service) was not calculated for thermal standards.

^{5/} The total energy savings for each state for thermal standards were adjusted based on appropriate factors of compliance (see Footnote 3 above).

V. 1979 ESTIMATED SECP ENERGY SAVINGS IN THE THERMAL
AND LIGHTING CATEGORY

Implementation of efficiency standards for thermal and lighting is mandated under the Energy Policy and Conservation Act (EPCA). Thermal standards are required for all new residential and non-residential buildings and those renovated buildings that the state deems appropriate. Lighting standards are mandatory for new and existing public buildings above a size specified by each state.

The ASHRAE 90-75 standards (sections 4-8), described as "thermal standards" provide the minimum energy conservation performance required of individual building components and the equipment used for heating, cooling, ventilating, and domestic water heating. Thermal standards affect the building's physical characteristics, e.g., exterior glass, exterior wall, and insulation.

Lighting standards (ASHRAE 90-75, section 9) are directed towards minimizing the use of electricity for lighting in public buildings by requiring compliance with lighting power budgets. The lighting power budget involves calculating the watts per square foot in a building task area and aggregating the task areas in a building to a single lighting budget.

A. Measure: Thermal Efficiency Standards

The states have almost exclusively used the standard methodology provided by DOE in the Sourcebook^{1/} to calculate their energy savings. In some cases, states have substituted state-

^{1/}State Energy Conservation Plan Handbook, Volume 2, Federal Energy Administration, Office of Conservation and Environment. NP21664/2.

specific data on the square footage of affected new and renovated construction (by building type) for extrapolated information developed using the DOE-supplied tables. Some states cited F.W. Dodge's Construction Potentials as a source for state-specific square footage information and other states collected actual permit data. A few states have conducted studies to determine the typical annual reduction of unit energy consumption as a result of the standards. However, a large majority of the states relied upon DOE-supplied information. Only one state, California, considered compliance as a factor in its methodology for calculation of energy savings.

Not all states that claimed savings for thermal standards have enacted legislation for mandatory compliance. Some states have claimed savings as the result of voluntary standards. As there is no evidence to support the premise that voluntary standards generate the same level of compliance as mandatory standards, the savings for these states have been eliminated from our analysis.

1. Units of Service

States have provided data on units of service for thermal standards (square feet of floor space affected) for the following ten building types covered by these standards:

- o Single Family;
- o Low Density;
- o Low Rise;
- o High Rise;
- o Office;
- o Retail;

- o School;
- o Hospital; and
- o Other.

Units of service provided by the states were adjusted taking into consideration compliance as a major factor affecting energy savings due to thermal standards. The study performed by the State of California Energy Commission was utilized to determine compliance with thermal standards as an exemplary evaluation approach. This study concluded that one year after implementation, 15 percent of new and renovated buildings are in compliance and 2 years after implementation, 70 percent have taken action towards compliance. These factors have been applied in the following way:

- (1) Establishment of the year in which the standards were implemented in each state;
- (2) Isolation of the units of service associated with implementation of thermal efficiency standards for each state; and
- (3) Application of the appropriate factor (.15 or .70) based on the number of years since implementation. (States implementing codes before 1979 will be multiplied by .70).

The appropriate units of service for thermal standards are, therefore, the square feet of affected building types in compliance.

2. Index

An index (Btu's of energy saved per square foot in compliance) was not calculated for thermal standards. It was determined to be infeasible due to (1) the complexity of calculating a single index (weighted by units of service) for all

ten building types for all states, and (2) the limitations of state provided data on units of service and energy savings by building type.

Twenty-two states provided appropriate energy savings data for new and renovated buildings. Energy savings were adjusted according to the appropriate compliance factor: .15 for one year of implementation or .70 for two or more years of implementation.

A report published by GAO (January 28, 1980) concluded that delays in the implementation of thermal standards (based on DOE's report that as of October, 1979, only 26 states were in compliance and 25 had been granted extensions) would result in a 34 percent loss in 1980 projected savings of 294 TBtu's. This would bring the 1980 estimate down to 194 TBtu's. We have used this 1980 reduced figure as a check on the reasonableness of our 1979 reduced savings total (48.9 TBtu's). The reduced 1979 savings total is a result of adjusting the units of service and the total energy savings for a state. Projected DOE 1980 savings are approximately three times the state reported 1979 savings. Similarly, the GAO reduced figure for 1980 savings is slightly more than three times 1979 total savings reduced by this assessment. The consistency of these findings lend additional validity to the findings presented.

B. Measure: Lighting Efficiency Standards

Almost all of the 26 states claiming savings as a result of lighting standards used the DOE standard methodology. The methodology does not require the state to report total square footage affected, only the fraction of total area in compliance. The state-supplied fraction is applied to the projected energy

consumption for lighting in public buildings (by building type in trillion Btu's).

For purposes of applying a reasonableness check on the lighting savings reported by the states, units of service and a weighted average index were computed for eleven states. These eleven states had implemented mandatory lighting standards and provided appropriate documentation to derive units of service and energy savings for new and renovated public buildings. Considering the same universe of new and renovated public buildings, a similar weighted average index was computed for eight of the eleven states for thermal standards. These weighted average indices and the percentages of total consumption represented by (a) lighting, and (b) space heating and cooling were compared. The comparison shows that the Btu's of energy saved per unit of service for lighting is higher than the Btu's of energy saved per unit of service for thermal, while consumption for lighting is significantly less than thermal. The reported energy savings are, therefore, questionable, and in the absence of a sound basis for making an adjustment, were eliminated from the analysis.

VI. 1979 ESTIMATED SECP ENERGY SAVINGS

IN THE

TRANSPORTATION CATEGORY

TABLE VI: SUMMARY OF ESTIMATED SAVINGS - TRANSPORTATION

Measure	Units of Service	Number of States Reporting Units of Service	Index (Btu's x 10 ⁶ Saved Per Unit of Service)	Energy Savings (TBtu's)	Dollar Value of 1979 Energy Savings ^{1/}	Dollar Value of Savings Over Estimated Life of Measure (Discounted at 10%)
55 MPH SPEED LIMIT	201.08 x 10 ⁹	20	.00025	50.27	\$ 336,809,000	\$ 336,809,000
RIGHT TURN ON RED	54,502	15	^{2/} 75	4.09	\$ 27,403,000	260,366,864 ^{3/}
TOTAL				54.36	\$ 364,212,000	597,175,864

^{1/} Based on weighted average price of gasoline and diesel fuels consumed by the transportation sector in 1979: \$.0000067 per Btu (see Appendix V for explanation).

^{2/} Based on survey performed by Virginia Highway and Transportation Research Council.

^{3/} Life is assured based on mandatory SECP through 1980 (2-year life). However, 15 years is assumed for consistency with other sectors. Discounted at 10% once each period (year) for 15 periods. Assumes that real price of energy oil will increase at 2.35% per year.

VI. 1979 ESTIMATED SECP ENERGY SAVINGS IN THE TRANSPORTATION CATEGORY

The transportation sector represents approximately seven percent of the total 1979 savings reported by states in the annual savings reports.

There are a variety of different transportation measures which were funded by the SECP grant program. These included:

- o Carpooling;
- o Vanpooling;
- o Mass Transit;
- o 55 MPH Speed Limit Enforcement;
- o Right Turn on Red;
- o Driver Education; and
- o Other measures infrequently occurring in a few state SECP plans.

A. Measures: Carpools, Vanpools, and Mass Transit

During a preliminary review of the state-provided documentation of programs utilizing various ridesharing options (i.e., carpools, vanpools and mass transit), it became apparent that a number of weaknesses in the data existed. Perhaps the most outstanding of these was that there appeared to be no studies which address the extent to which SECP funding had directly caused an increase in ridesharing behavior.

As virtually no reliable indicators of the portion of savings brought about by SECP were available, no estimation of the energy savings was compiled for carpools, vanpools and mass transit measures.

There are, obviously, considerable savings associated with these measures. However, rather than associate a false sense of

validity with such savings, these program measures were excluded from this review.

Where adequate energy savings estimates were derived, certain transportation measures were included, such as the following:

B. Measure: Enforcement of 55 MPH Speed Limit

1. Unit of Service

The unit of service utilized for this measure was the number of vehicle miles travelled (VMT) on roads where there is enforcement of the 55 MPH speed limit. This data element is obtained in most cases from standard state reports. In those cases where a state did not report VMT, an estimate of VMT was derived by multiplying the Oak Ridge National Laboratory's state-estimated VMT per capita by the state population and in turn by the ratio of roads covered by the 55 MPH speed limit to total VMT in reporting states.

A summary of the data used to generate total vehicle miles travelled (units of service) in the 20 states with this measure is shown below:

- a. Total Vehicle Miles Travelled (VMT_1) on roads where 55 MPH is in force reported by 12 states
 $= 179.41 \times 10^9$ miles.
- b. Total Vehicle Miles Travelled (VMT_2) per capita times population (n) in the 8 remaining states
 $= 39.4 \times 10^9$ miles.

- c. Ratio of $VMT_1 \div (VMT_2 \times n) = .55$ (averaged over 12 states in "a" above).
- d. Estimate of total vehicle miles travelled on roads where 55 MPH speed limit is enforced = $a + (b \times c) = 201.08 \times 10^9$ miles.

2. Index

The index for this measure was derived by averaging the Btu's per vehicle miles travelled obtained by six states whose energy savings reports were the most thoroughly documented.

These states utilized the standard TRW^{1/} approach to calculating energy savings associated with the 55 MPH speed limit enforcement shown below:

$$ES = AVMT \times \left(\frac{1}{MPG} - \frac{1}{MPG^1} \right) \times CF$$

In the formula:

AVMT = Annual Vehicle Miles Travelled

MPG = Vehicle miles per gallon determined by average maximum vehicle speed before measure implementation

MPG¹ = Vehicle miles per gallon determined by average maximum vehicle speed after measure implementation

CF = Conversion Factor $.125 \times 10^6$ Btu/gal.-gasoline
 $= .14 \times 10^6$ Btu/gal.-diesel fuel

^{1/}Standard Evaluation Methodology Packages for State Energy Conservation Programs HCP/M4143-01 Dist. Category UC-13, October 1978.

Utilizing this technique, an index of $.25 \times 10^3$ Btu's per vehicle mile travelled was obtained.

There is considerable variation between states in terms of the type of programs, number of miles of road affected, and the type and level of enforcement of the 55 MPH speed limit. These factors affected not only the quality of the data but caused actual differences in the Btu savings per vehicle mile travelled. The range of values for this particular index was from $.08 \times 10^3$ to $.41 \times 10^3$ Btu's per vehicle mile travelled.

3. Total Savings

Based on the results obtained from the above methods, an estimated 50.27 TBtu's were saved as a result of reduction in speed associated with the 55 MPH speed limit.

There is some question as to the degree to which these savings were brought about by SECP program efforts or expenditures. Savings associated with speed reduction could be caused by a variety of factors (e.g., increased price, safety concerns, etc.).

The savings estimated above address only those twenty states with 55 MPH enforcement programs accepted by DOE as falling under the auspices of the SECP.

C. Measure: Right Turn on Red

Right Turn on Red (RTOR) was one of the mandatory programs of SECP. Savings for this measure have been reported by 15 states.

1. Units of Service and Index

Early in the program development, the State of Virginia conducted a study which identified the average energy saved per signalized intersection where RTOR is allowed. The energy savings value obtained from this study was 75×10^6 Btu's per signalized intersection per year.

This study was used by nearly all states to calculate their energy savings. There appear to be two issues which the Virginia study has not addressed:

- 1) This methodology does not consider potential left turns on one-way streets in states where such turns are allowed.
- 2) It does not consider the number of potential approaches for signalized intersections that include one or two one-way streets.

However, in comparison to other energy savings methodologies utilized by states, it appears to be the most consistently applied. Therefore the units of service for this measure were defined to be signalized intersections, and the index selected was 75×10^6 Btu's per signalized intersection.

The total energy savings for this transportation measure were estimated to be 4.09 TBtu's.

D. Measures Not Included in Units of Service Analysis

The following transportation measures were not included in this review:

- o Carpools
- o Vanpools
- o Mass Transit

- o Driver Education
- o Vehicle Performance, Inspection, and Maintenance
- o Truck Weight Liberalization
- o Bicycles
- o Used Oil Recycling

APPENDICES

CONSIDERATIONS USED TO DETERMINE ATTRIBUTION OF
ENERGY SAVINGS TO SECP AND NON-SECP FACTORS

SECP Program Measure: Carpooling

	I SECP Only	II SECP & Other Factors	III Other Factors Only
OUTREACH	Driver A reads a "flyer" on the bulletin board at his office describing an SECP-sponsored carpool program.	Driver B is concerned about the high price of gasoline and calls an SECP hotline to inquire about SECP-sponsored carpooling programs.	Driver C is concerned about the high price of gasoline and is told by neighbors about a neighborhood carpool.
EDUCATION	The attitude of Driver A toward carpooling is changed due to an SECP public awareness program.	The attitude of Driver B is changed due to a combination of high prices and material received from an SECP.	The attitude of Driver C is changed toward carpooling due to high gasoline prices.
ACTION	Driver A joins a carpool.	Driver B joins a carpool.	Driver C joins a carpool.
SAVINGS	Attributable to SECP in total.	Attributable to both SECP and other factors.	Attributable only to non-SECP factors.

LIMITATIONS

The table on the following page presents a list of possible limitations in the estimates provided in this quick response study of 1979 SECP energy savings.

On the whole, the methods used and assumptions made in this quick response study are likely to be conservative. However, any categorical review or judgment of the accuracy of state reported energy savings must be deferred until completion of the validation study now being conducted by the Department of Energy.

Possible Limitations

A variety of factors affect the total energy savings figures generated by this study of SECP savings. These factors are outlined below by their potential impact on the estimates.

Likely to Inflate Estimates

1. Many of the savings estimates included in this report are based on the difference between energy savings achieved by SECP service recipients and energy saved by a comparison group of non-recipients.

This method assumes that all differences are attributable to the SECP program. It appears logical that those seeking SECP services would, of their own volition, be more predisposed to energy conservation than those not seeking such services. This potential bias would be likely to inflate estimates above actual energy savings.
2. In many cases, energy savings were estimates based on self-reports of energy conservation actions taken rather than actual utility or other energy bills. Such self-report data has in the past been found to be biased upward. For this reason such energy savings reports are likely to overestimate actual energy savings.
3. Some measures are virtually impossible to disaggregate into SECP-related vs. non-SECP related portions and, in some cases, both portions were included in the estimates (e.g., 55 MPH enforcement, thermal standards).

Uncertain Impact On Estimates

1. Usually, the methods used in this study assume that a standard energy savings per unit of service estimate is a reasonable reflection of the impact of services that vary greatly in both content and target populations. There is no reliable way of predicting the effect of such assumptions on the energy savings estimates presented in this report.
2. Several of the energy savings estimates were based on the similarity of SECP and EES target groups and services. In such cases, EES-based evaluation reports were utilized. However, it is possible that in the industrial sector, for example, the SECP services addressed, on the average, larger industries than did the EES small business program. As large industries can save more but are less likely to need or utilize state energy agency help, the impact of this inconsistency is not possible to predict.
3. The estimation methods used in this report are somewhat dependent on the accuracy of state-provided data. The quality and comprehensiveness of such data vary significantly across the states.
4. In some cases, a standard index was used to estimate energy savings across all states without adjusting for regional degree-day differences in heating and cooling load.
5. Many of the indices of Btu's saved per unit of service are based on very well documented states. The fact that such documentation exists may indicate that such states are not representative of all states to which the indices were applied.

Likely to Deflate Estimates

1. In many cases program measures were given credit for zero energy savings as a result of incomplete documentation. These programs almost certainly saved some energy. Therefore, such assessment decisions probably reduced savings estimates for such program measures below actual levels.
2. The estimates made here are intended to cover savings brought about by SECP services in all grant years (i.e., 1977-79) on 1979 energy savings. However, it is nearly certain that many states did not include 1977 and 1978 units of service in their 1979 annual reports. This bias is likely to underestimate actual savings.

Methodology to Adjust Reported
Savings Rates for Attribution

I. Industrial and Commercial Programs

- (1) 85.1%^{1/} firms which were treated by the programs that took action to conserve energy.
- (2) 72.8%^{1/} firms which were not treated by industrial and commercial programs which took action to conserve energy.
- (3)
$$\begin{array}{r} 85.1\% \\ - 72.8\% \\ \hline 12.3\% \end{array}$$
- (4)
$$\frac{12.3\%}{85.1\%} = 0.144$$
- (5) To adjust a reported savings per unit of service per year, the savings was multiplied by 0.144.

^{1/}Source: "Evaluation of the Energy Extension Service Pilot Program: The First Years," DOE/CS-0100.

II. Institutional Programs

- (1) 89.4%^{1/} Institutions which were treated by the programs that took action to conserve energy.
- (2) 84.8%^{1/} Institutions which were not treated by industrial and commercial programs which took action to conserve energy.
- (3)
$$\begin{array}{r} 89.4\% \\ - 84.8\% \\ \hline 4.6\% \end{array}$$
- (4)
$$\frac{4.6\%}{89.4\%} = 0.051$$
- (5) To adjust a reported savings per unit of service per year, the savings was multiplied by 0.051.

^{1/}Source: "Evaluation of the Energy Extension Service Pilot Program: The First Years," DOE/CS-0100.

Methodology to Adjust State and National
Indices for Attribution

In the "Evaluation of The Energy Extension Service Pilot Program: The First Year" (DOE/CS-0100) over 2,000 interviews in ten states yielded the following data:

- o 81.7 percent of those treated in residential programs (including Class A, B, and C audits) took action to conserve energy in the home;
- o 76.1 percent of those who were not treated by the residential programs (i.e., control group) also took action to conserve energy in the home.

To determine the impact of attribution, the difference between the test and control groups was calculated (5.6 percent). The ratio of 5.6 percent to 81.7 percent (or 5.6 divided by 81.7) was calculated. The result of the calculation provided a means to adjust a state or national index for attribution.

The following steps illustrate the procedures followed to make the attribution adjustment:

- (1) 81.7% -- individuals who were treated in the residential programs that took action to conserve energy in the home.
- (2) 76.1% -- individuals who were not treated in the residential programs that also took action to conserve energy in the home.

$$(3) \quad \begin{array}{r} 81.7\% \\ - 76.1\% \\ \hline 5.6\% \end{array}$$

$$(4) \quad \frac{5.6\%}{81.7\%} = .069$$

- (5) To adjust an index for attribution, the state or national index was multiplied by .0685434517.

For example: $1.4 \times .069 = .069$

METHOD USED TO DERIVE THE DOLLAR VALUE OF ENERGY SAVEDPricing Estimates

In order to convert the Btu's of energy saved to a dollar figure, it was first necessary to determine the price per Btu of energy saved in 1979. The following method was used:

- o For each of the four sectors, the average 1979 price per Btu for each of the fuels consumed was determined;
- o For each sector, a weighted average of the Btu's of different fuels consumed by the sector as a whole was determined; and
- o Based on the information in the two above steps, a weighted average price per Btu of all fuels consumed was determined for each sector.

Two sources of energy price data were utilized: Monthly Energy Review (MER, March 1980); and Monthly Petroleum Products Price Report, December 1979 (MPPPR, published March 1980). Generally, retail prices of the different fuels were utilized. The exceptions were in the industrial sector where for natural gas, LPG's, distillate and residual, either the wholesale price (natural gas) or an average of the wholesale and retail price was used.

The primary sources of data on fuel consumption by sector were the MER (March 1980) and the Energy Consumption Data Base (ECDB, Energy Information Administration, June 1978). The MER, for example, has data on the percentage of total industry Btu

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consumption attributable to petroleum. The ECDB, was used to disaggregate petroleum into various products; e.g., distillate, residual, LPG's and other.

The ECDB was also used to determine the relative percentages of different fuels consumed in the residential and commercial sectors. The MER could not be used because it consolidates residential and commercial into one table. Federal Highway Administration data were used to determine the percentages of gasoline and diesel fuel used on highways in the transportation sector.

It should be noted that in determining the price per Btu of electricity, a special adjustment was required. Since the Btu savings calculated for each of the sectors included "back to the powerhouse" savings, it was necessary to divide the end-sale price of electricity by three so as not to overstate dollar savings.

Life Cycle Value

The 1979 Btu savings estimates were multiplied by the weighted average price per Btu derived above to obtain the one year (1979) dollar value of energy saved by the program.

This one year dollar value was then escalated at 2.35% per year, over the estimated average life of conservation actions within each service category, on the assumption that the real price of energy will rise at that rate. The dollar value of savings over the estimated life of the measure was then discounted at 10 percent per year for the number of years consistent with the life of each program measure.

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