ENVIRONMENTAL IMPACT DETERMINATION

Based on

The State Energy Conservation Plan and
Environmental Assessment

Submitted to FEA by

The State of Michigan for Approval and
Funding under the Provisions

of

Title III, Part C of the Energy Policy and Conservation Act;
State Energy Conservation Program

Prepared by

The Office of Energy Conservation
Federal Energy Administration

I. Introduction

Title III, Part C of the Energy Policy and Conservation Act (EPCA) establishes the State Energy Conservation Program (SECP). The SECP will provide up to $22.5 million to the States and Territories in FY 1977 and up to $50 million in FY 1978 for implementation of State developed and State administered programs. Under the FY 1977 funding formula, Michigan is eligible for an award of $819,000. The objective of the SECP is to promote the conservation of energy and to reduce the rate of growth of energy demand.

An Environmental Assessment (EA) of the probable nationwide impacts of the SECP was undertaken by FEA. On the basis of said EA, a Determination was published in the Federal Register, Vol. 41, No. 117 (June 16, 1976) as follows:

> In accordance with FEA's obligations under the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.), an evaluation of the potential environmental impacts of the program for State energy conservation plans has been prepared by FEA. While certain adverse environmental impacts have been identified, they were found not to be "significant" as that term is used under NEPA. The overall impacts of the various program measures taken either separately or in combination are clearly beneficial.
>
> The nature and degree of environmental benefit will vary, however, among State energy conservation plans and from program measure to program measure. In the final analysis, the content of any particular State energy conservation plan will be determined by many factors peculiar to that individual State; these include local economic, employment, environmental, social, geographic and climatic conditions.
>
> The FEA evaluation, therefore, in addition to describing the environment to be affected by the plans, the impact of alternative measures likely to be included in the various State plans, and the maximum probable environmental impacts from the implementation of plans in all States, provides formulas for the use of the States which will allow them to compute the environmental residuals likely to flow from measures they propose. This information will be included in the plan reports submitted by the Governors. Prior to approving any plan or making any grants, FEA will review each State's submission of environmental data to determine whether it entails any significant effects on the quality of the human environment. In any case in which

FEA discovers significant effects, based on the information submitted and any supplemental information needed to make an informed judgment, an environmental impact statement will be undertaken by FEA. In cases where there are determined to be no significant effects, FEA will issue a negative determination of environmental impact, citing the State's submission in lieu of a formal environmental assessment pursuant to 10 CFR 203.4.

II. Findings

Michigan has provided a detailed breakdown of the environmental residuals changes associated with each of its proposed program measures. A review of Michigan's proposed conservation plan has been completed, by FEA, with the following results and observations:

- o No significant adverse environmental impacts are expected to result from plan implementation;
- o Beneficial environmental impacts from plan implementation are expected to have results that substantially outweigh any adverse impacts - but which are themselves not considered to be "significant" in the NEPA sense;
- o The nature of the process by which Michigan's plan has been developed has been such that the environmental factors have been identified and considered at each stage of development for each program measure.

III. Program Description

The objective of the SECP is the wise and efficient use of energy. That is:

- o To conserve energy - especially non-renewable fossil fuels;
- o To increase the number of output units per BTU of energy input, e.g., miles per gallon of gasoline, square feet of building space illuminated, heated or cooled per kilowatt hour, therm or gallon, etc.; and, in general

- To eliminate waste and inefficiency and, thereby, to promote economic, social, environmental and other benefits.

The program presently does not encompass, provide funding for, or otherwise encourage such actions as:

- Fuels switching;

- Changes in pollution control efforts, air or water quality standards, etc.

In other words, the program is designed primarily to operate within existing social, economic, environmental, political, legal, etc. constraints. The most tangible environmental effects, therefore, are likely to be the changes in environmental residuals which result from the changes in specific fuel consumption. These changes in all cases are net reductions in fuel use and are calculated by subtracting any small increase in energy use that may be occasioned by a program measure from the larger savings. For example:

- Increased use of commuter vanpools, carpools, or mass transit will reduce vehicle miles travelled by removing a number of commuter automobiles from the road. Additional fuel consumed by vans, buses, remaining commuter autos with higher occupancy rates and by autos freed for uses other than commuting as a result of the program must be subtracted in order to arrive at a net savings estimate.

- Reduced lighting levels in some buildings will, during the heating season in some climates, slightly increase fuel requirements for heating and decrease them for cooling. These changes have been shown to be insignificant in terms of environmental impact. The net impact is beneficial.

Because the most tangible environmental effects are the residuals changes resulting from the reductions in fuel use, the most reasonable approach to an environmental analysis, here, is to stress these first order (residuals) changes. This is best done by specific fuel use within each energy use sector.

IV. Impacts

A. General

The target of the Michigan plan, as a whole, is to reduce the State's 1980 energy consumption by 258.9 trillion BTU. This, measured against the 1980 baseline projection for Michigan of 3299.78 trillion BTU equals a 7.8 percent savings. Approximately 53 trillion BTU (20.5 percent) of savings come from the five required program measures.

These savings, measured across end use sectors, result in an absolute decrease in every environmental residual measured from each fuel consumed within each sector. The method of assessing the reduction in residuals was to compare the changes resulting from Michigan's projected fuel savings with a set of residuals calculated (by sector, by fuel) against FEA's baseline consumption forecast. A summary of these calculations is appended. The reductions range from a high of 7.0 percent for SOx to 1.2 percent for dissolved solids.

The tables below illustrate Michigan's energy consumption and projected savings by sector.

TABLE I

1980 Projected Consumption by Major Sector (%)

Sector	Direct Fuel (Minus Elect.)	Net (Incl. Elect.)
Residential	17.8	26.8
Industrial	22.9	34.5
Commercial	9.7	14.6
Transportation	24.0	24.0
Utilities	25.5	———

TABLE II

Projected Energy Savings by Sector (1980)

	Total (Primary Fuels)		Net(End Use)	
Sector	10^{12}BTU	%	10^{12}BTU	%
Res/Comm.Bldg.	86.3	33.3	90.0	34.8
Industrial	80.9	31.2	83.4	32.2
Transportation	33.4	12.9	33.4	12.9
Utilities	40.2	15.5	34.0	13.1
Other & Cross-Sectoral*	18.1	7.0	18.1	7.0
Total	258.9	99.9	258.9	100.0

* Government

Projected savings by program measure are listed in the appended abstracts from the Michigan plan.

From these tables, it can be seen that

- The residential and commercial sectors account for about 41 percent of total energy consumption and (through lighting and thermal efficiency programs) about 35 percent of projected savings; the government sector (where savings come predominantly from improved building efficiency) accounts for another 7 percent;

- The industrial sector is responsible for 34.5 percent of total consumption and about 32 percent of savings; while

- Transportation uses about 24 percent of the total consumption and accounts for about 13 percent of total savings; and

- About 26 percent of all fuels consumed are for the purpose of generating electricity purchased by the residential, commercial and industrial sectors.

It has been a common feature of all State plans reviewed to date that savings projected for transportation measures are low compared to other sectors and when compared to transportation's share of total consumption.

It must be kept in mind, here, that the SECP is a State program designed to impact in-State energy use over a relatively short time. Energy use within the transportation sector reflects:

- Long term national policy and investment, e.g., national emphasis, and investment in, highways as opposed to other transportation;

- The mix of vehicles currently on the road; and

- Land use patterns, infrastructure, and capital investments, in place, etc.

Opportunities - within the scope of the SECP - are limited within this sector, principally because major energy savings will involve a timeframe and level of investment outside the SECP limits and/or action at the national level. Given these transportation constraints, Michigan's plan reflects its fuel mix over the SECP timeframe.

As in the case of most States, Michigan's electrical purchases come from power generated both in and out of State. While the residuals change for the utilities sector is based on total fuel mix for all electricity purchased, the reductions will not all be in-State but will be, at least somewhat, regional in nature.

As a general statement, the residuals changes as well as the economic and employment impacts of Michigan's plan are expected to be beneficial, but not significant when viewed from the standpoint of:

- o the plan as a whole;
- o each individual program measure; or
- o sectoral impact.

While certain potential adverse impacts can be postulated, none are expected to be significant.

- o Where quantification has been attempted of some adverse impacts (as with CO emissions incident to new lighting standards in the nationwide case), it has been found that residuals changes are well within the margin of error associated with the projections against which they are measured and the impacts are insignificant.

- o In some cases, small adverse impacts have been accounted for and subtracted out in the process of computing the benefit, e.g., fuels used by vans and cars freed for uses other than commuting (as a result of carpooling and vanpooling) are subtracted from fuels saved prior to computing residuals changes.

- o An inflationary impact statement for the program was prepared and filed, in June 1976, with the Council on Wage and Price Stability. It stated that certain program measures, e.g., buildings insulation, vans, etc., may have an initial adverse economic impact in that the costs are front-end loaded (borne entirely at the time of purchase/installation) and the benefits are spread over a period of years. Over the life span of the improvement, however, all such investments identified were expected to produce beneficial economic impacts.

B. Specific Impacts

The major energy impacts have been grouped into four categories (buildings, industry, transportation and utilities) for purposes of describing potential environmental impacts. The quantifiable impacts are listed in the appended residuals tables and are, in all cases, beneficial. These are the result of reduced extraction, transport, processing, and burning of fossil fuels.

Additional, less tangible and less quantifiable, benefits which can be expected are reduced fuel bills resulting from lighting and thermal efficiency improvements in buildings, reduced capital investment in the utilities and fuels producing sectors as a result of all measures as well as reductions in employment related commutation costs. These impacts, on the whole, are expected to be mildly anti-inflationary. Reductions in highway congestion will be insignificant.

1. Residential and Commercial Buildings

The measures listed in the Michigan plan under the residential and commercial headings (see Appendix II) extend, reinforce and implement the mandatory thermal and lighting standards. Likewise, those listed under government extend and reinforce the procurement practices measure; these, with the exception of some small savings in transportation fuels, will impact building efficiencies.

In addition to those impacts discussed above, improvements in lighting and thermal efficiency involve some potential impacts as discussed below.

- o Manufacture and Installation of Weatherization Materials

  The impact of the actual installation of improvements and repair work will be insignificant. The aggregate environmental impacts can be divided into two major effects: environmental benefits associated with reduced fuel consumption, and small but possibly adverse environmental effects associated with the production of materials to retrofit the structures specified. The important consideration here is that while any adverse environmental effects will terminate when the program expenditures terminate, the environmental benefits will continue to accrue as long as the subject buildings are consuming heating fuel at a rate below their pre-retrofit levels.

Increased costs to building owners - either residential or commercial - resulting from increased insulation, more energy efficient equipment, fenestration, etc., whether in the case of new construction or retrofit, appear to be negligible. In fact, all information, to date, indicates that, over a very short (5 to 10 years) payback period, these measures are extremely cost beneficial, i.e., the investment is more than offset by reduced fuel bills.

- o Other Conservation Devices and Materials

  The manufacture of devices such as clock thermostats may result in minor, but unquantifiable, emissions, but certainly far less than the reduced emissions attributable to their use.

- o Reduced Levels of Lighting and Heating

  The nationwide case (Programmatic EA) referenced above makes note of the potential for minor, seasonal, increases (on the order of 0.1 percent) in CO as a result of increased heating needed in some buildings to offset heat loss when lighting levels are reduced. However, Michigan's method of assessment was to account for net fuel changes resulting from all program measures (and their interactions) within this area (lighting and heating). The environmental residual calculations which followed - based on these net fuel use changes - showed no quantifiable adverse impacts.

  Health effects from reduced heating and cooling levels are negligible - and presumed to be, on the whole, beneficial, i.e., in most cases heating, cooling, and lighting levels with the proposed standards are thought to be more healthful than existing levels; in addition, the reduction in pollutants is beneficial.

2. Transportation

While a significant amount of energy is consumed in the transportation sector in Michigan (see Table I), major changes in transportation fuels use will occur only with infrastructure and vehicle efficiency changes which are (compared to other savings opportunities) slower, more capital intensive, and/or inter- rather than intrastate in character and therefore outside the scope of the SECP.

From the implementation of the required transportation program measures, Michigan expects to realize an energy savings of 33.4 trillion BTU's in 1980, about 13 percent of the total savings expected from plan implementation. While comparatively small, this reduction in fuel consumption and thus in environmental residuals will have a beneficial impact.

The promotion of vans and carpools may have small adverse secondary impacts:

- The fuel used by vans, as well as the increased consumption per auto when the number of occupants is increased, has been subtracted from fuel savings prior to estimating residuals changes. The net change is, in all cases, beneficial, but not significant.

- The increased emissions from the manufacture of the vans have not been determined but are judged to be negligible when compared to reduced operating emissions from autos. This impact is likely as well to be offset by reduced auto manufacture.

- Vehicle inspection and maintenance, driver education, increased enforcement of the 55 mph speed limit, waste oil recycling and the bicycle mode measures will all involve initial start-up costs as well as operating expenses. However, all are expected to be cost effective, i.e., to produce economic savings which outweigh their costs. The social and ecological impacts, while small, are beneficial.

3. Industry & Agriculture

Michigan's opportunities for savings in the industrial sector are comparatively large. The major components of these savings will be:

- More energy efficient processes: these generally will be industry or plant specific measures which, by increasing unit output per BTU input will have beneficial - but not significant - economic as well as residuals impacts;

- Buildings efficiency improvements in the industrial sector are similar to those discussed under Section IV-B.2 above;

- To the extent that the industrial sector may experience adverse environmental impacts as an indirect result of increased demand, for example, for insulation materials or for vans attributable to other program measures, these impacts are discussed in the sector

where these program measures have their direct impact. The economic impact of such factors, of course, is beneficial to industry.

In the agricultural sector, an energy audit measure and a crop drying demonstration are proposed. These are educational and technology transfer programs which will promote voluntary adoption of cost effective and energy saving techniques and equipment.

4. Utilities

A comprehensive load management program is proposed with target savings of 34 trillion BTU in 1980. This will involve not only internal utilities management but demonstration projects and financial incentives to encourage consumers in all sectors to reduce peak hour demand. Because of the educational and incentive nature of the program and the voluntary participation by consumers, the measure is expected to produce economic benefits to both utilities and their customers in addition to the residuals decline noted elsewhere.

V. Alternatives

Under EPCA, there are no alternatives to the five mandatory program measures other than a State's non-participation in the SECP. The "no-participation" alternative, in all cases, is adverse when compared to the implementation of any mix of these five measures.

There is little room within the SECP timeframe for major structural changes affecting the way energy is used. Nor does an individual State have much say over the energy intensity or efficiency of many products used within its borders but produced and sold on a national basis. Rather, the emphasis of the SECP is on greater efficiency of energy use within the short term constraints imposed by presently in-place infrastructure, capital investment, land-use patterns, buildings, motor vehicle stock, and the like. Given this situation as well as current State-specific fuel distribution and use patterns, the reduction in residuals for any State program, including Michigan's, will not be uniform across all residuals but will tend to be skewed in such fashion as to conform to current fuel uses and specific savings opportunities and the particular characteristics of the fuels affected. In all cases the net result will be beneficial.

VI. Conclusions

In summary, it is the determination of FEA that Michigan's Environmental Assessment of its proposed plan complies with the requirements of both NEPA and the SECP Guidelines as promulgated by FEA.

Based upon our review of this EA, FEA has determined that actions now required to be taken to implement Michigan's proposed energy conservation plan under Title III, Part C of the EPCA will not be "major Federal actions significantly affecting the quality of the human environment." (Section 102(2)(C), National Environmental Policy Act, 42 U.S.C. 4332 (2)(C)). Consequently, no EIS preparation is contemplated for this action.

Appendices

I. Baseline Residuals Case and Residuals Changes

II. Abstracts from the Michigan Plan

STATE ENERGY CONSERVATION PROGRAM
ESTIMATED CHANGES IN ENVIRONMENTAL RESIDUALS
(projected for 1980)

STATE Michigan

I WATER

	Acids	Bases	Dissolved Solids	Suspended Solids	Organics	B.O.D.	C.O.D.
Baseline Case	7.93E+03	9.12E+02	4.78E+04	8.13E+03	3.44E+03	3.09E+03	5.09E+05
Reduction	-	2.01E+01	5.69E+02	1.79E+02	1.66E+02	5.11E+01	3.13E+02
Percent Reduction	-	2.2	1.2	2.2	4.8	1.7	6.2

II AIR

	Particulates	NO_x	SO_x	Hydrocarbons	CO	Aldehydes	CO_2
Baseline Case	2.95E+05	8.06E+05	4.88E+05	2.26E+05	1.66E+06	1.29E+04	2.31E+08
Reduction	1.85E+04	4.32E+04	3.43E+04	1.26E+04	8.29E+04	1.12E+03	1.74E+07
Percent Reduction	6.3	5.4	7.0	5.6	5.0	8.6	7.5

III OTHER

	Thermal Rejection	Solid Waste	Occupational Deaths	Occupational Injuries	Occupational Days Lost		
Baseline Case	1.52E+14	1.01E+07	7.13E+01	1.29E+03	9.58E+04		
Reduction	1.46E+12	1.85E+05	1.57E+00	3.58E+01	2.36E+03		
Percent Reduction	2.3	1.8	2.2	2.8	2.5		

Footnotes:
Entries given in scientific notation, e.g., 3.86 E04 equals 3.86 x 10^4 or 38,600; ( ) denotes minus value.
Unit values are:
- o For air, water, and solid waste: tons per year;
- o For thermal rejection: BTU per year; and
- o For deaths, injuries, and days lost: individual (single) occurrences.

TALLY SHEET

OF REDUCTIONS IN EMISSIONS, ETC.

(AIR)

	Particulates	NO_x	SO_2	Hydro-Carbons	CO	CO_2	Aldehydes
1 Automobile Operation	2,207.2	10,288.4	534	7,155.6	75,472	2,652,000	---
2 Diesel Engine	41.13	1,166.4	85.32	114.3	708.3	76,500	18.63
3 Residential S.H., Gas & LPG	265.188	3,659.25	8.897	113.652	277.816	1,750 [illegible] 2,750,700	139.482
4 Residential S.H., Distillate Oil	394.144	754.062	1487.305	405.153	226.72	926,500	123.606
5 Residential, Coal	177.56	50.36	302.16	19.336	82.44	44.400	.532
6 Commercial, Gas & LPG	285.825	4822.254	9.7026	300.348	300.348	1,884,900	151.41
7 Commercial, Distillate Oil	532.518	2,259.714	1278.285	345.681	697.5	790,500	106.02
8 Commercial, Residual Oil	1,657.242	4,696.83	11,188.35	753.48	71.829	1,759,500	155.25
9 Commercial, Coal	177.56	50.35	302.16	19.336	82.44	44.400	.532
10 Industrial, Gas & LPG	320.975	5415.282	10.8958	137.065	337.284	2,116,700	170.03
11 Industrial, Distillate Oil	200.41	850.43	481.075	130.095	262.5	297,500	39.9
12 Industrial, Residual Oil	1825.368	5173.32	1323.4	829.92	79.116	1,938,000	171
13 Industrial, Coal	8833.61	2505.41	15,032.46	961.966	4099.599	2,208,900	26.467
14 Electrial Generation, Oil-Fired	1222.08	1539.66	2239.14	1334.64	166.58	3,417,000	301.5
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State: Michigan

TALLY SHEET

OF REDUCTIONS IN EMISSIONS, ETC.

(WATER)

	ACIDS	BASES	DIS. SOLIDS	SUS. SOLIDS	NON-DEG. ORG	BIO. O.D.	CHEM. O.D.
1 Automobile Operation	---	---	---	---	---	---	---
2 Diesel Engine	---	---	---	---	---	---	---
3 Residential S.H., Gas & LPG	---	---	---	---	.574	---	---
4 Residential S.H., Distillate Oil	---	---	4.36	8.284	26.269	8.284	50.794
5 Residential, Coal	---	.396	10.68	2.308	---	---	---
6 Commercial, Gas & LPG	---	---	---	---	.618	---	---
7 Commercial, Distillate Oil	---	---	3.72	7.068	22.32	7.068	43.338
8 Commercial, Residual Oil	---	---	8.073	15.732	49.887	15.732	96.462
9 Commercial, Coal	---	---	.396	10.68	2.308	---	---
10 Industrial, Gas & LPG	---	---	---	---	.694	---	---
11 Industrial, Distillate Oil	---	---	1.4	2.66	8.4	2.66	16.31
12 Industrial, Residual Oil	---	---	8.892	17.328	54.948	17.328	106.248
13 Industrial, Coal	---	19.701	531.33	114.823	---	---	---
14 Electrial Generation, Oil-Fired	---	---	---	---	---	---	---
15							

TALLY SHEET

OF REDUCTIONS IN EMISSIONS, ETC.

(OTHER)

	Thermal Reject	Occupational Death	Occupational Injury	Occupational Man-day Lost	Solid Waste
1 Automobile Operation	---	---	---	---	---
2 Diesel Engine	---	---	---	---	---
3 Residential S.H., Gas & LPG	25.543	.00574	.861	25.83	---
4 Residential S.H., Distillate Oil	---	.00763	.543	27.25	523.2
5 Residential, Coal	---	.028	.488	36.88	3478.4
6 Commercial, Gas & LPG	27.501	.00618	.927	27.56 2867.52	---
7 Commercial, Distillate Oil	---	.00651	.465	23.25	446.4
8 Commercial, Residual Oil	---	.01499	1.0143	52.164	994.014
9 Commercial, Coal	---	.028	.488	36.88	3,478.4
10 Industrial, Gas & LPG	30.883	.00694	1.041	30.881 3220.16	---
11 Industrial, Distillate Oil	---	.00245	.175	8.75	168
12 Industrial, Residual Oil	---	.01596	1.1172	57.456	1094.856
13 Industrial, Coal	---	1.393	24.278	1834.78	173050.4
14 Electrial Generation, Oil-Fired	3376.8	.05226	4.3818	201.804	1929.6
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TABLE 1

TITLE: Automobile Operation, Direct Air Emissions
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-Degradable Org.			
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	62	35.6	2,207.2
Oxides of Nitrogen	289	35.6	10,288.4
Sulfur Dioxide	15	35.6	534
Hydrocarbons	201	35.6	7,155.6
Carbon Monoxide	2,120	35.6	75,472
Carbon Dioxide	74,500	35.6	2,652,200
Aldehydes			
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)			
Occupational Injuries (Men)			
Occupational Man Day Lost (Man-day)			
Solid Waste Tons			

TABLE 2

TITLE: Diesel Engine, Direct Air Emmissions
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-Degradable Org.			
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	45.7	.9	41.13
Oxides of Nitrogen	1,296	.9	1,166.4
Sulfur Dioxide	94.8	.9	85.32
Hydrocarbons	127	.9	114.3
Carbon Monoxide	787	.9	708.3
Carbon Dioxide	85,000	.9	76,500
Aldehydes	20.7	.9	18.63
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)			
Occupational Injuries (Men)			
Occupational Man Day Lost (Man-day)			
Solid Waste Tons			

TABLE 3

TITLE: Residential Space Heat, Natural Gas and LPG
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-Degradable Org.	.02	28.7	.574
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	9.24	28.7	265.188
Oxides of Nitrogen	127.5	28.7	3659.25
Sulfur Dioxide	.31	28.7	8.897
Hydrocarbons	3.96	28.7	113.652
Carbon Monoxide	9.68	28.7	277.816
Carbon Dioxide	61.000	28.7	1750700
Aldehydes	4.86	28.7	139.482
OTHER			
Thermal Rejection (Btu)	.890	28.7	25.543
Occupational Death (Men)	.0002	28.7	.00574
Occupational Injuries (Men)	.03	28.7	.861
Occupational Man Day Lost (Man-day)	.9	28.7	25.83
Solid Waste Tons			

TABLE 4

TITLE: Residential Space Heat, Distillate Oil
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.	.4	10.9	4.36
Suspended Solids	.26	10.9	8.284
Non-Degradable Org.	2.41	10.9	26.269
Biological Oxygen Dem.	.26	10.9	8.284
Chemical Oxygen Demand	4.66	10.9	50.794
AIR (TONS)			
Particulates	39.16	10.9	394.144
Oxides of Nitrogen	69.18	10.9	754.062
Sulfur Dioxide	136.45	10.9	1487.305
Hydrocarbons	37.17	10.9	405.153
Carbon Monoxide	20.8	10.9	226.72
Carbon Dioxide	85,000	10.9	926500
Aldehydes	11.34	10.9	123.606
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)	.0007	10.9	.00763
Occupational Injuries (Men)	.05	10.9	.545
Occupational Man Day Lost (Man-day)	2.5	10.9	27.25
Solid Waste Tons	4.8	10.9	523.2

TABLE 5

TITLE: Residential, Coal
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases	.99	.4	.396
Dissolved Solids, Mis.	26.7	.4	10.68
Suspended Solids	5.77	.4	2.308
Non-Degradable Org.			
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	443.9	.4	177.56
Oxides of Nitrogen	125.9	.4	50.36
Sulfur Dioxide	755.4	.4	302.16
Hydrocarbons	48.34	.4	19.336
Carbon Monoxide	206.1	.4	82.44
Carbon Dioxide	111,000	.4	44400
Aldehydes	1.33	.4	.532
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Man)	.07	.4	.028
Occupational Injuries (Man)	1.22	.4	.488
Occupational Man Day Lost (Man-day)	92.2	.4	36.88
Solid Waste Tons	8,696	.4	3478.4

TABLE 6

TITLE: Commercial, Natural Gas and LPG
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-Degradable Org.	.02	30.9	.618
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	9.25	30.9	285.825
Oxides of Nitrogen	156.06	30.9	4822.254
Sulfur Dioxide	.314	30.9	9.7026
Hydrocarbons	3.95	30.9	122.055
Carbon Monoxide	9.72	30.9	300.348
Carbon Dioxide	61,000	30.9	1884900
Aldehydes	4.9	30.9	151.41
OTHER			
Thermal Rejection (Btu)	.89	30.9	27.501
Occupational Death (Men)	.0002	30.9	.00618
Occupational Injuries (Men)	.03	30.9	.927
Occupational Man Day Lost (Man-day)	92.8	30.9	2867.52
Solid Waste Tons			

TABLE 7

TITLE: Commercial, Distillate Oil
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.	.4	9.3	3.72
Suspended Solids	.76	9.3	7.068
Non-Degradable Org.	2.4	9.3	22.32
Biological Oxygen Dem.	.76	9.3	7.068
Chemical Oxygen Demand	4.66	9.3	43.338
AIR (TONS)			
Particulates	57.26	9.3	532.518
Oxides of Nitrogen	242.98	9.3	2,259.714
Sulfur Dioxide	137.45	9.3	1,278.285
Hydrocarbons	37.17	9.3	345.681
Carbon Monoxide	75	9.3	697.5
Carbon Dioxide	85,000	9.3	790,500
Aldehydes	11.4	9.3	106.02
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)	.0007	9.3	.00651
Occupational Injuries (Men)	.05	9.3	.465
Occupational Man Day Lost (Man-day)	2.5	9.3	23.25
Solid Waste Tons	48	9.3	446.4

TABLE 8

TITLE: Commercial, Residual Oil
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.	.39	20.7	8.073
Suspended Solids	.76	20.7	15.732
Non-Degradable Org.	2.41	20.7	49.887
Biological Oxygen Dem.	.76	20.7	15.732
Chemical Oxygen Demand	4.66	20.7	96.462
AIR (TONS)			
Particulates	80.05	20.7	1,657.242
Oxides of Nitrogen	226.9	20.7	4,695.83
Sulfur Dioxide	540.5	20.7	11,182.35
Hydrocarbons	36.4	20.7	753.48
Carbon Monoxide	3.47	20.7	71.829
Carbon Dioxide	85,000	20.7	1,759,500
Aldehydes	7.5	20.7	155.25
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)	.0007	20.7	.01449
Occupational Injuries (Men)	.049	20.7	1.0143
Occupational Man Day Lost (Man-day)	2.52	20.7	52.164
Solid Waste Tons	48.02	20.7	994.014

TABLE 9

TITLE: Commercial, Coal
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.	.99	.4	.396
Suspended Solids	26.7	.4	10.68
Non-Degradable Org.	5.77	.4	2.308
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	443.9	.4	177.56
Oxides of Nitrogen	125.9	.4	50.36
Sulfur Dioxide	755.4	.4	302.16
Hydrocarbons	48.34	.4	19.336
Carbon Monoxide	206.1	.4	82.44
Carbon Dioxide	111,000	.4	44,400
Aldehydes	1.33	.4	.532
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)	.07	.4	.028
Occupational Injuries (Men)	1.22	.4	.488
Occupational Man Day Lost (Man-day)	92.2	.4	36.88
Solid Waste Tons	8,696	.4	3,478.4

TABLE 10

TITLE: Industrial, Natural Gas and LPG
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-Degradable Org.	.02	34.7	.694
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	9.25	34.7	320.975
Oxides of Nitrogen	156.06	34.7	5415.282
Sulfur Dioxide	.314	34.7	10.8958
Hydrocarbons	3.95	34.7	137.065
Carbon Monoxide	9.72	34.7	337.284
Carbon Dioxide	61,000	34.7	2116700
Aldehydes	4.9	34.7	170.03
OTHER			
Thermal Rejection (Btu)	.89	34.7	30.883
Occupational Death (Man)	.0002	34.7	.00694
Occupational Injuries (Man)	.03	34.7	1.041
Occupational Man Day Lost (Man-day)	92.8	34.7	3220.16
Solid Waste Tons			

TABLE 11

TITLE: Industrial, Distillate Oil
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.	.4	3.5	1.4
Suspended Solids	.76	3.5	2.66
Non-Degradable Org.	7.4	3.5	8.4
Biological Oxygen Dem.	.76	3.5	2.66
Chemical Oxygen Demand	4.66	3.5	16.31
AIR (TONS)			
Particulates	57.26	3.5	200.41
Oxides of Nitrogen	242.98	3.5	850.43
Sulfur Dioxide	137.45	3.5	481.075
Hydrocarbons	37.17	3.5	130.095
Carbon Monoxide	75	3.5	262.5
Carbon Dioxide	85,000	3.5	297500
Aldehydes	11.4	3.5	39.9
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)	.0007	3.5	.00245
Occupational Injuries (Men)	.05	3.5	.175
Occupational Man Day Lost (Man-day)	2.5	3.5	8.75
Solid Waste Tons	48	3.5	168

TABLE 12-

TITLE: Industrial, Residual Oil
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.	.39	22.8	8.892
Suspended Solids	.76	22.8	17.328
Non-Degradable Org.	2.41	22.8	54.948
Biological Oxygen Dem.	.76	22.8	17.328
Chemical Oxygen Demand	4.66	22.8	106.248
AIR (TONS)			
Particulates	80.06	22.8	1825.368
Oxides of Nitrogen	226.9	22.8	5173.32
Sulfur Dioxide	540.5	22.8	1323.4
Hydrocarbons	36.4	22.8	829.92
Carbon Monoxide	3.47	22.8	79.116
Carbon Dioxide	85,000	22.8	1,938,000
Aldehydes	7.5	22.8	171
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)	.0007	22.8	.01596
Occupational Injuries (Men)	.049	22.8	1.1172
Occupational Man Day Lost (Man-day)	2.52	22.8	57.456
Solid Waste Tons	48.02	22.8	1094.856

TABLE 13

TITLE: Industrial, Coal
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases	.99	19.9	19.701
Dissolved Solids, Mis.	26.7	19.9	531.33
Suspended Solids	5.77	19.9	114.823
Non-Degradable Org.			
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	443.9	19.9	8833.61
Oxides of Nitrogen	125.9	19.9	2505.41
Sulfur Dioxide	755.4	19.9	15032.46
Hydrocarbons	48.34	19.9	961.966
Carbon Monoxide	206.01	19.9	4099.599
Carbon Dioxide	111,000	19.9	2208900
Aldehydes	1.33	19.9	26.467
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)	.07	19.9	1.393
Occupational Injuries (Men)	1.22	19.9	24.278
Occupational Man Day Lost (Man-day)	92.2	19.9	1834.78
Solid Waste Tons	8696	19.9	173050.4

TABLE 14-

TITLE: Electrical Generation, Oil-Fired Steam
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-Degradable Org.			
Biological Oxygen Dem.			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	30.4	40.2	1222.08
Oxides of Nitrogen	38.3	40.2	1539.66
Sulfur Dioxide	55.7	40.2	2239.14
Hydrocarbons	33.2	40.2	1334.64
Carbon Monoxide	2.9	40.2	116.58
Carbon Dioxide	85,000	40.2	3417000
Aldehydes	7.5	40.2	301.5
OTHER			
Thermal Rejection (Btu)	.89	40.2	3376.8
Occupational Death (Men)	.0013	40.2	.05226
Occupational Injuries (Men)	.109	40.2	4.3818
Occupational Man Day Lost (Man-day)	5.02	40.2	201.804
Solid Waste Tons	48	40.2	1929.6

TABLE 2-4

STATE CREDITED ENERGY SAVINGS IN 1980

SECTOR	TBTU SAVINGS	% OF SECTOR	% OF TOTAL
Residential	~~36.0~~ 46.2	~~6.2~~ 8.0	~~1.1~~ 1.4
Commercial	43.8	15.5	~~1.4~~ 1.3
Industrial	~~50.8~~ 80.2	~~6.1~~ 7.6	~~1.6~~ 2.5
Elec. Generation	34.0	5.0	~~1.1~~ 1.0
Transportation	33.3	4.7	1.0
Government	~~16.5~~ 18.1	~~20.0~~ 21.0	.5
Agriculture	3.2	11.9	.1
TOTAL	~~217.3~~ 258.9	--	~~6.8~~ 7.9

SUMMARY

Sector	Total 1980 Btu Savings	Cost
Residential	~~36.0~~ 46.2	185,000
Commercial	43.81	75,000
Industrial	~~50.8~~ 80.2	110,000
Agriculture	3.2	63,000
Transportation	33.3	66,000
Power Generation	34.0	-0-
Government	~~16.5~~ 18.1	116,000
Sub-Total	~~217.6~~ 258.9	615,000
Computerized Data		23,000
Personnel and Materials		181,000
TOTAL		819,000

Residential

Program Measure	Name	Btu	Cost
1	Thermal Efficiency Stds for new & renovating residences	6.6 trillion	$15,000/year
2	Hot water stds for new & renovating residences	4.32 "	none--costs from other ASHRAE related measures
3	Mich. Modified "Project Conserve"	19.3 "	77 -- 145,000 78 -- 305,000 further costs as justified by results
4	Infra-Red Audits	.1 "	77 -- 25,000 78 -- 50,000 further costs as justified by results
5	Weatherization	.51 "	no EPCA funds involved
6	Passage of Law requiring mandatory installation of furnace orifices and five restrictors in new or resold residences	~~5.2~~ 15.4 "	"
1977 TOTAL		~~36.0~~ 46.2 trillion	185,000

Commercial

Program Measure	Name	Btu	Cost
1	Thermal Efficiency Stds for New & Renovating Public Bldgs.	4.5 trillion	Accounted for in other measures; no direct EPCA funds involved.
2	Water Heating Stds for new & renovating Public Bldgs.	.21 "	"
3	Lighting Efficiency Stds for Public Bldgs.	17.4 "	77 -- 15,000 78 -- 35,000
4	Multiple option program	16.3 "	77 -- 50,000 78 -- 113,000
5	Approved Energy Mgt in health care inst.	5.4 "	77 -- 10,000 78 -- 15,000
1977 TOTAL		43.81 trillion	$75,000

Transportation

Program Measure	Name	Btu	Cost
1	Carpools	19.2 trillion	77 - 25,000 78 - 45,000
2	Vanpools	.5 "	77 - 15,000 78 - 25,000
3	Public Transportation	4.7 "	77 - 5,000 78 - 15,000
4	Right-turn-on-red	.1 "	no EPCA funds required
5	Vehicle performance inspection & maintenance	2.8 "	77 - 15,000 78 - 25,000
6	Driver Education & training program measure	2.3 "	77 - 5,000 78 - 15,000
7	Increased enforcement & compliance w/the 55 mph speed limit	1.5 "	not available at this ti
8	Waste (used) oil recycling	2.2 "	77 - 1,000 78 20,000
9	Bicycle Mode	~~not estimated~~ .13	77 - 0 78 - 10,000
1977 TOTAL		33.3 trillion	$66,000

Government

Program Measure	Name	Btu	Cost
1	Energy efficient procurement practices	negligible	77 - 26,000 78 - 45,000
2	State government energy mgt.	2.2 trillion	77 - 15,000 78 - 30,000
3	Energy mgt. in local gov't., public schools and colleges and univ.	14.3 "	77 - 32,000 78 - 50,000
4	Feasibility studies of solid waste mgt. & recycling programs in local gov't.	1.6 negligible before 1980 - increasing thereafter	77 - 43,000 78 - 50,000
1977 TOTAL		18.1 ~~16.5~~ trillion	$116,000

Industrial

Program Measure	Name	Btu	Cost
1	Technology Sharing	~~45.1~~ 70.9 trillion	77 -- 45,000 78 -- 90,000
2	Audits of small & medium industry	5.7 "	77 -- 35,000 78 -- 75,000
3	Subsidized feasibility studies of co-generation & materials recycling	~~potential is high, unable to estimate now~~ 3.6	77 -- 30,000 78 -- 40,000
1977 TOTAL		~~50.8~~ 80.2 trillion	$110,000

Power Generation Efficiency

Program Measure	Name	Btu	Cost
1	Comprehensive load mgt. program	34.0 trillion	77 -- 0 78 -- 95,000
1977 TOTAL		34.0 trillion	0

Production Agriculture

Program Measure	Name	Btu	Cost
1	Farm energy audit & education program	10% reduction in farm energy consumption or 2.9	77 - 44,000 78 - 55,000
2	Crop drying demonstration	.3 trillion	77 - 19,000 78 - 12,000
1977 TOTAL		3.2 trillion	$63,000