

**PRELIMINARY ANALYSIS OF CARTER'S
ENERGY CONSERVATION PLAN WITH
RESPECT TO NEW ENGLAND ISSUES***

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* This report was prepared in the period immediately after the March 20, 1977 energy policy speech made by President Carter. It therefore does not reflect the subsequent detailed legislative package.

SUMMARY

President Carter's energy plan will, in all likelihood, be helpful to the country, to the New England region, and to the people of New England in that it appears that it will:

- * provide better mechanisms to secure equalization of price of energy throughout the country. For example, natural gas and oil prices in New England are heavily dependent on the higher foreign prices. (90% of New England energy is petroleum based, 70% of that is imported). Raising prices of natural gas and oil will help this region achieve parity with the rest of the country.

- * increase the price gradually, hence easing the economic and social impact of the inevitable price increases that will occur as petroleum reserves are depleted.

- * accelerate the introduction of new technologies such as solar energy through tax incentives provided in the Carter plan.

- * encourage conservation through insulation tax incentives and through gradual increases in the Carter plan.

The issues behind Carter's plan will demand serious and intensive analysis to give the New England policy makers strategies to assure that the interests of the region, the states and the people of New England are upheld. The speech made by President Carter on March 20, 1977 leaves out many details that will be important for indepth analysis. Further, there are many questions and uncertainties, especially as to the effects on supply that the plan as was stated on March 20, 1977 does not answer. This quick reaction is not an indepth study but rather a starting point.

The following includes brief comments on some aspects of Carter's proposal.

1. INSULATION (AND OTHER HOMEOWNER ENERGY SAVING MEASURES)

20% of all energy consumed in New England and 10% of all energy consumed in the United States is consumed in home heating. As the price of energy goes up this sector will be affected and in all likelihood, consumption will to some extent be curtailed. The idea of the Carter program to encourage conservation in the home is sound.

What is needed for the public policy in the region is information as to what home improvements are the best and most effective for this region.

Included in this section are two analyses that we have produced using the MIT regional computational facility. The first analysis gives insight into the character of the housing stock in Massachusetts. The second analysis gives cost benefit analysis of various home improvements. Such an analysis could be helpful to homeowners in the region.

1.1 Housing Stock in Massachusetts

The "average" or modal home in Massachusetts was built between 1945 and 1965 and is a two-story house with 1630 square feet of living area. It has an unheated but insulated attic and has 16 windows and 2 doors. Doors and windows have storm covers but only about half the windows are weather stripped. It is heated by oil at a cost of \$572 per season. Table 2 gives the detailed breakdown of the description of the homes in this subsample.

The "average" or modal home also has a color TV and a frost free refrigerator, an electric stove, oven and dryer, and its water is heated by either gas or oil. Table 3 gives a detailed description of energy use.

TABLE 1

1977 HOUSING STOCK

| | Uninsulated Housing Stock (000) | | | | Total Housing Stock* (000) | Total Uninsulated Homes As Percent of Total Stock (%) |
|--------------------------|---------------------------------|------------------------|-----------------------|------------|----------------------------|---|
| | Single Family Detached | Single Family Attached | Multi Family Low-rise | Total | | |
| Connecticut | 49 | 67 | 24 | 140 | 996 | 14.1 |
| Maine | 30 | 23 | 8 | 61 | 290 | 21.0 |
| Massachusetts | 103 | 196 | 67 | 366 | 1824 | 20.1 |
| New Hampshire | 18 | 17 | 7 | 42 | 234 | 17.9 |
| Rhode Island | 18 | 34 | 8 | 60 | 306 | 19.6 |
| Vermont | 14 | 11 | 3 | 28 | 126 | 22.2 |
| TOTAL NEW ENGLAND | 232 | 348 | 117 | 697 | 3776 | 18.5 |

* Total housing stock is the sum of both insulated and uninsulated single family-detached homes, single family-attached homes and multi-family low rise units in 1977.

SOURCE: "Simulation Model of Residential Space Heating and Central Air Conditioning in New England Disaggregated by State, 1970-2000" by Richard Daifuku for NEEMIS, February 1977.

TABLE 2

BASIC HOME DESCRIPTION - Massachusetts*

| | | | |
|----------------------|-------------|----------------------------------|----------|
| <u>Year Built</u> | | <u>Storm Windows</u> | |
| Prior to 1920 | 23% | Avg. | 84% |
| 1920-1945 | 22% | | |
| 1945-1965 | 39% | <u>Storm Doors</u> | |
| 1965-Present | 16% | Avg. | 77% |
| <u>Type of House</u> | | <u>Weather Stripping Windows</u> | |
| One Story | 32% | Avg. | 56% |
| Split Level | 8% | | |
| Two Stories | 54% | <u>Weather Stripping Doors</u> | |
| Three Stories | 6% | Avg. | 62% |
| <u>Living Area</u> | | <u>Attic</u> | |
| Max. | 2500 sq.ft. | Present | 93% |
| Min. | 750 sq.ft. | Absent | 7% |
| Avg. | 1629 sq.ft. | <u>Heating Attic</u> | |
| <u>Central A/C</u> | | Present | 5% |
| Present | 9% | Absent | 95% |
| Not Present | 91% | <u>Attic Insulation</u> | |
| <u>Winter Fuel</u> | | Avg. | 3 inches |
| Gas | 29% | | |
| Oil | 64% | | |
| Propane | .1% | | |
| Electric | 7% | | |
| Coal | .1% | | |
| Kerosene | 0 | | |
| <u>Winter Bill</u> | | | |
| Max. | \$1050 | | |
| Min. | \$ 150 | | |
| Avg. | \$ 572 | | |

*Source: Project Conserve - a sample of 135,000 single family homes in New England

TABLE 3
BASIC ENERGY USE*

Winter Temperature Setting

Day

| | |
|-----|------|
| Min | 65 |
| Max | 76 |
| Avg | 69.2 |

Evening

| | |
|-----|------|
| Min | 65 |
| Max | 76 |
| Avg | 69.2 |

Night

| | |
|-----|------|
| Min | 65 |
| Max | 76 |
| Avg | 67.9 |

Summer Temperature Setting

Day

| | |
|-----|------|
| Min | 70 |
| Max | 79 |
| Avg | 76.7 |

Night

| | |
|-----|------|
| Min | 70 |
| Max | 79 |
| Avg | 76.7 |

Percentage Owning

| | |
|-------------------------|------|
| Color TV | 79.7 |
| Outside Gas Light | 1.8 |
| Frost Free Refrigerator | 73.3 |
| Frost Free Freezer | 20.4 |

*Source: Project Conserve - a sample of 135,000 single family homes in New England

1.2 Cost-Benefit Analysis of Home Improvements

The proposed Carter program features an income tax credit for insulation and weather-proofing of residential structures of 25% on the first \$800 and 15% on the next \$1500 invested in home insulation, storm windows and/or storm doors.

Figure 1 and Figure 2 depict break-even points incorporating the tax incentive for various possible home improvements. This analysis is for a New England home having seven rooms, thirteen windows and an attic of approximately 1440 square feet. Break-even periods are calculated for three improvement scenarios: 1). installation of thirteen storm windows; 2). installation of two storm doors; 3). installation of 6-inch faced fiberglass insulation in the attic floor or roof.

The initial cost for the installation of storm windows was assumed to be roughly \$500. Two storm doors were assumed to cost \$140 (\$70 each). These costs are considered high and thus conservative. The cost of 1440 square feet of 6-inch insulation is \$288. All insulation prices were obtained from quotations by Owens-Corning for the Boston area and do not include installation charges.

The energy consumption of households for space heating was derived from R. Tabors and S. Raskin, "The Cost of a Cold Winter to New England Homeowners," and is defined to be oil consumption per household for a normal heating season. Consumption in each of the New England states was averaged to obtain consumption for an average New England household.

The discount rate is the risk-free rate of 5.75 percent and a time horizon of ten years is used.

Fuel prices for the state and the region are oil prices, also from Tabors and Raskin (1977), and the fuel price inflator is taken to be the increase in oil prices in 1976, tabulated by the same source. The inflator was .12 for Massachusetts and .107 for the New England region.

Energy savings rates for each of the five improvements are based on M.I.T. Study: 14% for storm windows; 7% for storm doors; 14% for 6-inch faced insulation.

The input parameters are summarized in the following table:

| | 13 Storm Windows | 2 Storm Doors | 6 inch insul. |
|----------------------------|---------------------|------------------|------------------|
| Cost | \$520 | \$140 | \$288 |
| Mass. (gal) Consumption | 1831 | 1831 | 1831 |
| N.E. (gal) Consumption | 1372.50 | 1372.50 | 1372.50 |
| Discount rate | 5.75% | 5.75% | 5.75% |
| Time Horizon (yr) | 10 | 10 | 10 |
| Fuel Price Mass. \$ | .46 | .46 | .46 |
| Fuel Price N. E. \$ | .463 | .463 | .463 |
| Mass. Inflator | .12 | .12 | .12 |
| N.E. Inflator | .107 | .107 | .107 |
| Savings rate | | .07 | .14 |

TABLE 4
Input Parameters for Cost Benefit Analysis

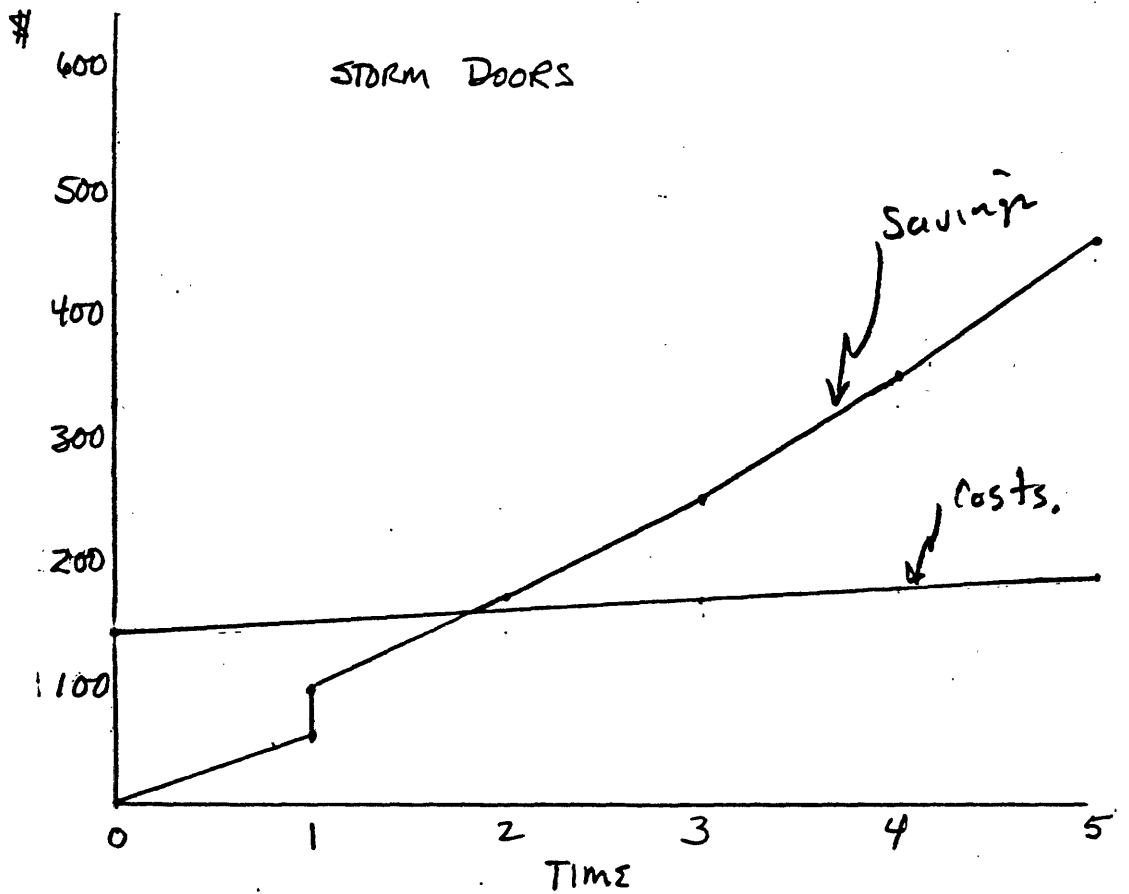
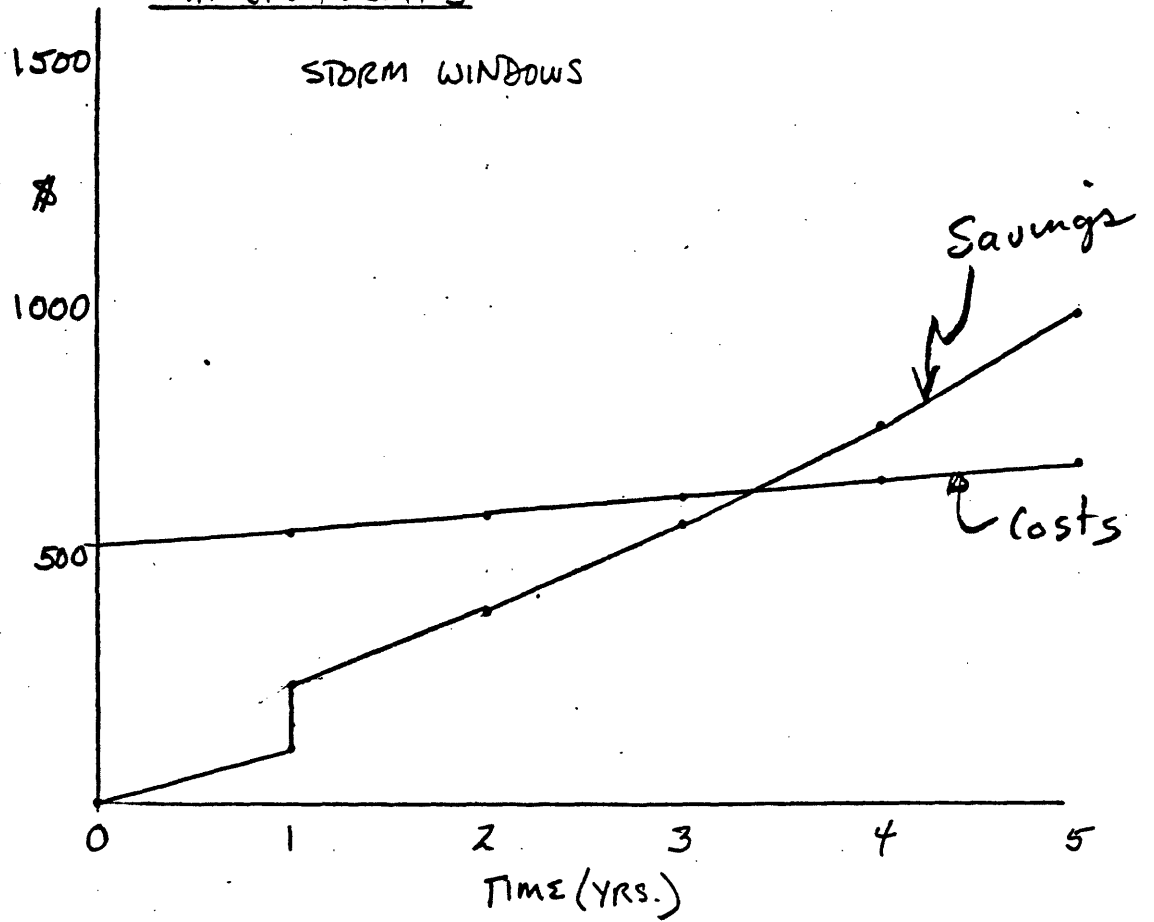


Figure 1 - Storm Windows//Storm Doors

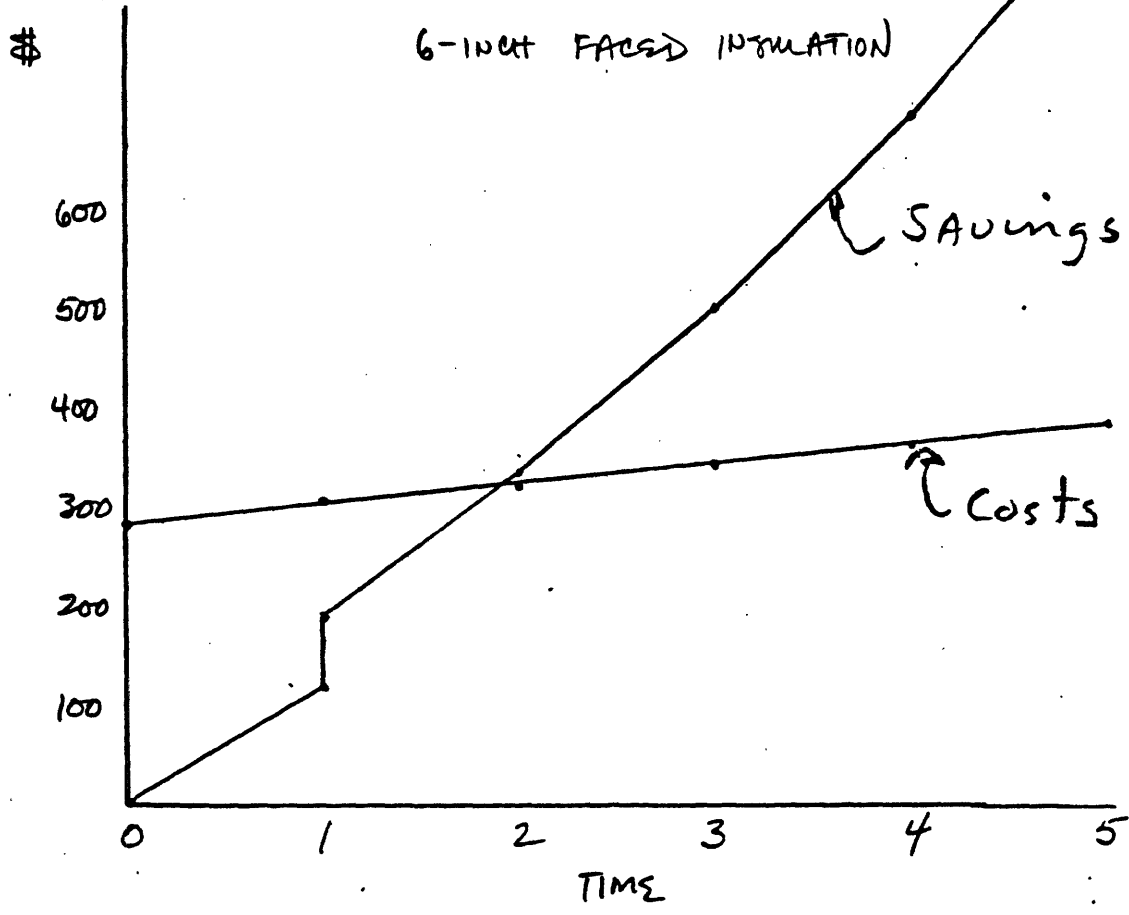


Figure 2 - Insulation

As indicated, all scenarios appear to have a break-even (payback) period of less than four years. The installation of storm doors and 6 inches of attic insulation each pay pack their initial investment costs in less than two years.

Three of the input parameters were altered and analysis completed to determine the sensitivity of the results to input change. Using the base parameters for New England, lowering the price inflator from .107 to .09 (an estimate of inflation in New England) had no appreciable affect on the results. Decreasing the energy savings rate for each improvement by one-half did have an appreciable affect. Storm doors and 6-inch insulation still maintained a payback period of less than 5 years. Decreasing the cost of a storm window from \$40 to \$30 and of a storm door from \$70 to \$50 resulted in an appreciable improvement in an already short payback period.

The implications of this analysis are two-fold. First, each of the home improvements described under the initial assumptions are economically justified for our "average" household. (Assuming an average turnover rate of 5 years or more) the Carter proposed tax credit is an incentive for home improvement. It decreases the payback period in all cases from one-half year to a full year. Finally, it should be realized that the results of this analysis are merely illustrative in that they depend on the characteristics of the specific structure, costs and prices involved.

2. GASOLINE TAXES

The basic idea of gradually raising prices of gasoline is good for New England and the country for several reasons - among the most important are:

- It will allow the country to adjust gradually both economically and socially to what now appears to be the inevitability of higher prices.
- It should result in the accelerated introduction of more energy efficient automobiles.

There are issues with respect to the Carter proposed mechanism of a tax that the New England governors must address. Among these are:

- We suspect that the per capita mileage driven is less for New Englanders than for other regions, e.g., Southern California, hence this tax may affect the region less than other regions. However, the cost of transportation may go up.

- What is the price elasticity of gasoline in New England relative to that for the nation as a whole? If it is higher here than for the rest of the country, it is conceivable that New Englanders could reduce their consumption below the trigger point, but the rest of the country may not do so, hence bringing increased taxes despite regional "success."

3. NATURAL GAS

Efforts leading to eventual deregulation of natural gas may be economically beneficial for New England as prices are equalized for the country as a whole. The benefits include:

- New England currently pays higher prices for natural gas than do most other regions in the country. As prices rise, New England's prices will rise relatively less as compared to the rest of the country.

- In New England 53% of natural gas is used in residences while only 25% is used in industry and 19% in commercial activities. The 53% used by residences will be "old" gas under the Carter plan, and hence not subject to early increases.

- In general, price increases cause lower average consumption (negative elasticity), thus rises in natural gas prices should cause a long-run decline in household consumption.

4. COAL (AND PRICE PARITY ON ALL FORMS OF ENERGY)

The idea of letting prices of various presently inexpensive but exhaustible forms of energy rise and encouraging the use of coal is sound. Such actions may make the transition smoother. Issues of concern to New England with respect to coal include:

4.1 Quantity and Quality of Resources

There is some dispute as to how large "knowns coal resources" are (e.g., 1400 billion metric tons [Brown, 1976], to 16 billion metric tons [Schmidt and Hill, 1976]). Part of the difference can be accounted for by the differentiation of "resources and reserves," where reserves are deposits of quality and magnitude that can be easily and economically mined at present; and resources represent total known deposits. To be considered targets for development, coal must be of relatively high quality (high heating value and low sulfur content), occurring in relatively thick, uniform and extensive beds close to the surface. It appears that there may be coal deposits in the Naragansett Bay area; its recovery will depend on the quality and amount of these indigenous deposits and on national demands and other reserves of higher quality. National coal reserves are significantly larger than oil reserves and as a result, will play a larger role in our efforts toward long-run energy security and transition.

4.2 Transportation and Distribution

For coal to be of use in New England serious attention must be given to the transportation (railroad) capacity.

The railroad is the essential link between coal producers and the utilities. At present, the rail industry's challenge is to upgrade its facilities to further reduce the costs of delivering coal to New England. New England is the "end of the line" for the unit train. Road beds need further improvement and if trains must travel under "slow rules," transport time and costs are increased even further.

To the extent that New England can affect railroad policy, further transport and distribution of coal should receive regional policy attention to anticipate the long lead times required for major improvements in regional systems operation.

The Carter plan calls for maintenance of air quality controls that are carefully enforced in the urban areas of New England. As a result, coal combustion must be carried out with extensive air cleaning equipment or in areas out of air quality control regions such as that planned for Secvi's Island, Maine.

4.3 Environmental

The ash content of coal ranges from 4 to 15% or from 80 to 300 pounds of ash or slag created with the burning of one ton of coal. The amounts of solid waste from these facilities require extensive transportation and land filling programs.

4.4 Utility Acceptance of Coal

The Carter plan calls for the reconversion of a number of presently oil and gas fired power plants back to coal. The importance of this conversion can be seen in the fact that utility coal consumption dropped from 5.0 million tons in as recently as 1969 to 1.1 million tons in 1973 and 2.1 million tons in 1974. While it is unclear exactly which plants might be affected by such a regulation, a number of plants such as the Cambridge Electric Plant at Kendall Square, a recent convert, and the Hartford Electric Light Company, at Middletown, will be up for consideration, though stiff environmental regulations may block coal at both sites.

4.5 Summary

For coal to be viable for New England transport bottlenecks for coal must be eased, environmental regulations must be met and suitable attention must be given to disposal of ash.

5. CONCLUSIONS

New England is furthest from sources of United States coal production and is projected to remain with a reliance on foreign oil. New England is closest to foreign petroleum and furthest from United States sources of energy. It will be the least secure region under any United States energy supply scenario. Hence, the New England region's energy security problems are even more acute and sharply focused than other United States regions, and its high cost of energy focuses attention on the economic and social problems of energy source transition. For these reasons, energy problems facing New England will, in many respects, be the forerunners of those facing other regions.

6. WHAT CAN NEEMIS DO WITH RESPECT TO THE CARTER PLAN?

Using the MIT regional energy capability the NEEMIS Project at MIT is in a particularly advantageous position to do the following:

- Conservation: NEEMIS has in operation the computer programs, data procedures, training, building analysis capability to meet the President's goal of the federal, state and local government in setting an example by reducing consumption in government buildings for heating (20% in old buildings and 45% in new buildings).
- Conservation: NEEMIS project has in place the models, analytical capability and has done much of the analysis to assist the homeowner in New England in evaluating the best home improvement alternatives.
- Solar: The NEEMIS project at MIT by virtue of its close working relationship with members of the MIT Energy Laboratory working on solar, is in a particularly advantageous position to advise the policymakers and the New England homeowner of realistic, economical and technologically feasible uses and direction.
- State Eligibility for Federal Funding: The NEEMIS project through its use of the NEEMIS building analysis programs in state and local government buildings will assist the states in procurement of the proposed matching federal funds for improvements to those buildings.
- Proposing Alternatives: The NEEMIS project has the potential for providing New England policy makers with needed information for them to take an active role in proposing alternatives.

- Analysis of Issues: The NEEMIS unique computational facility provides the region with the best tools available anywhere for analysts to use to address the issues and implications of the Carter plan.
- Starting Point: The present NEEMIS models and data provide a base to start to analyze the yet to be specified taxes, rebates and other issues of his plan and of the ensuing New England energy situation.
- Production and Conversion: In addition to the existing "capital" interest in the NEEMIS project, the close proximity, interchange and personal relationshipd with members of the MIT Energy Laboratory offers the region a direct pipeline into leading research in the production and conversion issues of energy. The MIT research, under sizeable grants with high quality efforts includes technological, economic and policy implications of the production and conversion on energy (coal, nuclear, fluidized bed combustion, solar, world oil, etc.).

This work places the NEEMIS project in a particularly advantageous position to supply to NERCOM, the states, and the region the badly needed information (often unattainable elsewhere) on these matters.
- Yet Unforeseen Problems: The NEEMIS project was specifically designed tool to handle unforeseen economic and energy problems, Coupled with a pool of regional experts (in economics, data processing, statistics, energy), NEEMIS could assure that the best interest of the region was served.
- In Summary: The foresight of NERCOM, the New England states, MIT, IBM and other sponsors of the NEEMIS project is now on the verge of paying big dividends. The region stands unique in its ability to react, propose and implement a comprehensive energy plan because of NEEMIS.