

# MAINE STATE LEGISLATURE

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STATE OF MAINE  
ONE HUNDRED AND SEVENTH LEGISLATURE

COMMITTEE ON ENERGY

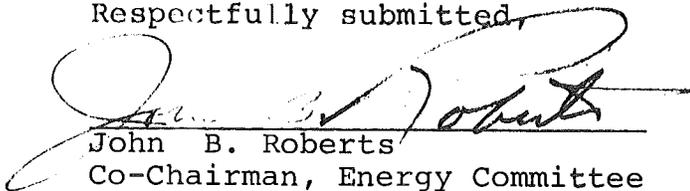
February 13, 1976

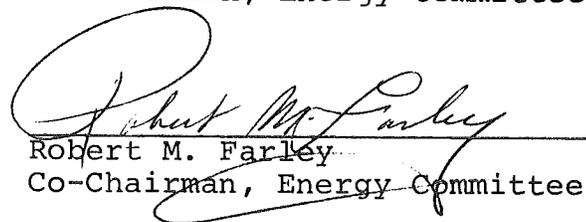
Senator Jerrold B. Speers, Chairman  
Legislative Council  
State House  
Augusta, Maine

Dear Senator Speers:

In accordance with House Paper 1540, directing the Committee on Energy to study the subject-matter of L.D. 746, "AN ACT Concerning Loans Made By Savings Banks For Housing Meeting Certain Energy Conservation Standards", we enclose herein the final report of the Committee.

Respectfully submitted,

  
John B. Roberts  
Co-Chairman, Energy Committee

  
Robert M. Farley  
Co-Chairman, Energy Committee

enclosure  
TP/sym

Report of the Committee  
on Energy  
On Its Study of  
An Energy Conservation Construction Code

February 13, 1976

Senate

John B. Roberts, Chairman  
Howard M. Trotzky  
Alton E. Cianchette

House

Robert M. Farley, Chairman  
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## Introduction and Background

Maine is and will continue to be in the near future dependent on fossil fuels for heating homes either directly by the use of oil burning heaters or indirectly by using electric heaters. Increasing costs of fuel oil - as much as 100% in a period of 2 years - coupled with the knowledge that domestic fuel oil supplies are finite makes it imperative that Maine reduce its consumption of fuel oil. Capital for massive research projects or expensive currently feasible alternative energy sources is not available in Maine. Therefore, practical reasonable alternatives to conserve fuel are necessary.

The Joint Standing Committee on Energy was directed by the Legislative Council during the Regular Session of the 107th Legislature to study a bill, L.D. 746 "An Act Concerning Loans Made by Savings Banks for Housing Meeting Certain Energy Conservation Standards" per House Paper 1540, and to report its findings together with any proposed recommendations and necessary implementing legislation to the Special Session of the 107th Legislature. L.D. 1746 proposed to allow savings banks to loan new home purchasers up to 95 per cent of the market value of new homes that meet energy conservation standards established by the Maine Housing Authority.

The Joint Standing Committee on Energy broadened its study to determine available means to achieve the goal of reduced energy consumption in new and existing Maine homes. Two major methods are available. One method is called retrofitting which generally applies to measures undertaken to reduce or eliminate the loss of heat by any means from the interior of a building and to prevent the introduction of cold air into the living space. The other method most commonly used is called a performance standard for

building construction. This means that a particular unit must be constructed so that it will use a specific number of BTU's per square foot per hour to maintain a particular temperature. Both methods are effective, available and achievable without excessive capital expenditures. Home builders using the performance standard will be able to predict operating costs for home energy throughout the lifetime of the home or owners. Better planning for available resources can be made.

### Retrofitting

Fuel consumption can be reduced as much as 45%. The cost of the retrofitting measures for the average home is estimated at \$200-\$500, if the home owner does the work himself.

Information is available to help a home owner determine which techniques would result in the greatest energy savings for each dollar spent. Simple mathematical calculations can be made on existing and new construction to determine heat loss and costs of retrofitting. Heat loss takes place most commonly through windows, walls, roof, floor and openings. Air is introduced through ventilation systems, spaces and cracks. Heat transfer occurs in three ways; conduction through the construction elements of the building, infiltration through openings and radiant energy emissions. Insulation retards the conduction of heat. Reflective materials reduce radiant heat loss. Weather stripping etc. minimizes infiltration.

The common method to measure the total heat transfer rate of a particular building element, the U value, is measured in BTU per hour x square foot x 1° F (1° F is the amount of heat (BTU) trans-

ferred in one hour through 1 square foot of the section from the warm to the cool side when there is 1° F temperature difference). Low U values indicate good insulation properties and designates the total heat transmission rate of a building element. R factor is a value expressing the ability to retard heat transfer - the inverse of U factor,  $U=1/R$ . By adding the R factors of a building's elements and taking the inverse one calculates the U factor.

Degree days are calculated by determining the difference between 65°F and the mean temperature for the day multiplied by the number of days in the heating season. Maine averages 7000-8500 degree days. The differences in U value between an insulated surface and uninsulated surface multiplied by degree days can show heat savings  $U_1$  (uninsulated) -  $U_2$  (insulated) Btu/hr. x ft.<sup>2</sup> x °F x sq. ft. in area. x degree days.= no. Btu. Btu can be easily translated into gallons of fuel oil and consequently dollars. There are 136,200 BTU per gallon of no. 2 fuel oil. Determining the number of Btu's necessary to heat a given space before and after retrofitting can be converted into dollars. This way a home owner can determine whether the annual savings justifies the expense and can determine the long term benefit. In the same way the lending organization can determine the number of extra dollars that will be available to repay a loan that might be necessary for the initial expenditure.

At the present time Maine has no State wide mandatory building code construction standards or minimum U factor for new buildings. Efforts to conserve energy have therefore been voluntary. Determining the necessity, the methods and the effectiveness of

the measures undertaken is left to individuals. Improperly or insufficiently applied insulation materials can be detrimental to the building structure causing continued heat loss and condensation problems. Standards and education can combine to eliminate these problems.

The quantitative Energy savings possible can be determined for Maine by multiplying the total fuel oil used by the percentage of savings possible and multiplying by the cost per unit.

An Energy Conservation Construction Code

An energy conservation construction code is one direction that the State of Maine can take. One alternative is to mandate an energy conservation construction code for the State. A second alternative is to mandate a state-wide, uniform building code that contains energy conservation provisions. A third alternative is to allow municipalities and unincorporated towns to voluntarily adopt an energy conservation code or building code.

L.D. 746, presented to the Committee on Energy during the 107th Regular Session, proposed that the Maine Housing Authority (MHA) promulgate the energy code for the State. The MHA intended to adopt the ASHRAE 90-P Standard prepared by the American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. for Congressional consideration. The MHA proposed that Maine adopt an energy standard promulgated by the federal government for federal construction and federal energy conservation construction grants to the State.

The Arthur D. Little Company analyzed the ASHRAE 90-P Code for the Federal Energy Administration in regard to energy savings resulting from the adoption of the Code. According to the A. D. Little Report of December 1975, the following energy savings would be realized:

1. Single family residences - 10.7%
2. Low-rise Apartment Buildings - 42.7%
3. Office Buildings - 59.7%
4. Retail Stores - 40.1%
5. School Buildings - 48.1%

The ASHRAE 90-P Standard was analyzed by a group of engineers and architects at a conference in Maine on November 26, 1975. The conclusion of the conference was that the ASHRAE 90-P Standard is a gradual "belt-tightening" energy standard that, in the long run, can produce substantial energy savings. The criteria established in the ASHRAE Code are initially moderate in order to provide a 3-year lag time for equipment manufacturers and contractors to meet the increasingly tighter standards of the Code.

The Maine ASHRAE 90-P Conference also concluded that small business contractors may not be able to operate under the Code because of the technical aspects of the energy standard. Furthermore, adoption of the ASHRAE 90-P Standard will require a training program for building inspectors in Maine. Under the ASHRAE 90-P Code, building inspectors must make mathematical calculations to measure the heat transfer rate (The "U" factor) of various types of construction and the resistance (The "R" factor) rate of various types of materials which are duties that are not required under present law.

According to Professor Richard Hill of the Department of Industrial Cooperation of the University of Maine in Orono and a panel member of the Maine ASHRAE 90-P Conference, the federal government will provide \$50,000,000 in 1976 for energy conservation to the 50 states through various federal agencies (FEA, ERDA, etc.) The conservation grants will be contingent upon State adoption of the ASHRAE 90-P Code. If Maine adopts the Code, most of the funds granted to the State in 1976 for conservation would be used for a training program for building inspectors. Subsequent funding, however, would be available for all other conservation projects that obtain federal approval.

The Maine ASHRAE 90-P Conference concluded that the ASHRAE Standard should be used as a guide on a voluntary basis at the present time. Some features of the Standard could be adopted immediately such as the equipment (heating, cooling, lighting) specifications in order to prevent the sale of energy consuming equipment in Maine that cannot be sold in other states. Maine could gradually adopt the various provisions of the ASHRAE Standard and phase into the standard.

The ASHRAE Code establishes standards for various regions of the nation in regard to the heat transfer and resistance rates of construction. In Maine, for example, the envelope of a home (the space between the outside wall of the home and the inside wall surrounding the home) must have a heat transfer rate not to exceed .2 BTU per square foot per hour (BTU/sq.ft./hr). The heat transfer rate of residences (3 stories or less) for ceilings cannot exceed .05 BTU/sq.ft./hr and the heat transfer rate of floors cannot exceed .08 BTU/sq.ft./hr. According to the participants in the conference, these requirements are not excessive and can produce substantial energy savings.

The ASHRAE Code therefore, is a performance code that does not mandate the use of specific construction materials or designs. As long as the heat transfer rate of the structure meets the maximum established in the code, the contractor can use any material or designs to build the structure.

A second alternative is to mandate a state-wide building code that contains energy conservation provisions. The Maine Home Builders Association proposes that the BOCA Code (Building Officials and Code Administrators International, Inc.) be adopted as a state-wide building code. Presently, the BOCA Code is the state building code for all public buildings and schools in Maine.

The BOCA Code is one of four national building codes in the United States. The Southern Building Code, the National Building Code, and the International Building Code are national codes that have been adopted in different regions in the United States. The BOCA Code is oriented primarily toward the northeastern states. The three southern New England States have adopted the BOCA code as a state-wide code.

According to Francis Crowley, a mechanical engineer for the Bureau of Public Improvements, the BOCA code does not presently contain any specific insulation or other energy conservation requirements. BOCA officials, however, are in the process of considering incorporating the ASHRAE Standard into the BOCA 1976 supplement to the basic code.

Roughly 145 communities in Maine have building codes, but the codes do not necessarily include residences. Some codes pertain only to nursing homes or to agricultural buildings or to some other type of building. Thus, more than 350 communities in the State do not have a building code. Approximately 20 communities follow the National Building Code, and roughly 40 communities use the BOCA code, including Portland.

A mandatory building code would require a comprehensive training program to train local building inspectors. The Home Builders Association of Maine suggest that a Maine Building Code Board to consist of 5 members, including one public member, would provide or approve the training for all local building officials. The training program would be funded by revenues collected from building permit fees.

In order to enforce the building code, local enforcement agencies or regional enforcement agencies would be created. The enforcement agencies would enforce the laws, ordinances and regulations enacted by the local governments in regard to the construction, alteration, repair, demolition, and location of buildings as well as the BOCA code itself.

Any individual dissatisfied with a decision of a local enforcement agency or appeals board, could appeal the decision to the Administrative Court.

A state-wide building code may generate opposition from small contractors and from some of the 350 communities in the State which presently do not follow the BOCA code. In addition, some communities which have adopted the National Building Code may also oppose the adoption of the BOCA code.

#### Components of an Energy Code

In order to establish a code or to promote the construction of optimum energy conserving structures, it is necessary to establish criteria to measure energy conservation. Professor James Shottafer, a wood technologist in the Department of Forestry at the University of Maine in Orono, suggested that the following criteria be the basis of an energy code or for the promotion of specific types of construction:

- (1) The energy required to produce construction materials.
- (2) The heat transfer rate of construction and insulation materials.
- (3) The energy utilization rate of various home construction designs.

(1) Energy required to produce various construction materials E. L. Klein and P. W. Eldridge of the Forest Economics and Marketing Section of the Tennessee Valley Authority report in the Southern Lumberman that wood

requires less energy to harvest, produce, and process than any other construction material available on the market. James R. Turnbrell, Executive Vice-President of the National Forest Products Association, reports that 1 ton of lumber requires 430 kilowatt hours (KWH) of electricity or its equivalent to produce compared to 2,700 KWH for 1 ton of steel and 17,000 KWH for 1 ton of aluminum.

Klein, Eldridge, and Turnbrell point out that the energy crisis may increase the demand for wood construction materials because other products will become too expensive for the consumer. By the year 2000, the increase demand for wood, particularly home construction, will probably exceed natural production. The authors point out that increased demand can be met by better forest practices and forest management which would increase production to meet the demand.

(2) Heat transfer rate of construction material. In addition to the energy required to produce construction materials, the heat transfer rate of the materials is another factor to consider in regard to energy construction standards. Wood technologists point out that wood has the lowest heat loss or transfer rate of any construction material. The table below statistically describes the heat loss rate of the various materials.

Findings listed below show heat loss of various materials 1" thick, 12" square, with only 32 degrees difference between inside and outside temperatures.

	Wood.....25 BTU's per hr.
HEAT	Glass.....186 BTU's per hr.
LOSS	Steel.....9,984 BTU's per hr.
	Aluminum.....45,312 BTU's per hr.

A study conducted at Arizona State University between 1972 and 1973 that compared identical sized wood and masonry structures revealed that an all wood home is 42% more economical to heat and cool. "During the heating season of December, January, and February, the wood structure required 251 operating hours, while the masonry required 304 hours."

James Turnbrell of the National Forest Products Association conducted a study which revealed that the insulating characteristics of wood exceed those of any other basic construction material. Four inches of wood has the insulation quality of 5 feet of concrete. Compared with other building materials, Turnbrell's study shows that "wood insulates 6 times better than brick, 15 times better than concrete, and 1,770 times better than aluminum".

(3) Energy utilization rate of various home construction designs.

Building design, in addition to construction and insulation materials, is significant in regard to energy conservation. Ralph J. Johnson, Vice President of the National Association of Home Builders, points out that compact homes with window space of 10 per cent of the floor area lose substantially less heat than L, T, and H shaped dwellings with a window area of 15 per cent of the floor area. A 24' x 50' home with a 20' x 20' L has the same area as a 32' x 50' house, but the former will sustain a greater heat loss of 1,000 BTUH. A home in which the window area is 10 per cent of the floor area and double glazing and storm sash are used will sustain a heat loss that is 8,700 BTUH less than a home which does not have double glazed windows and storm sash. The same home with poor fitting windows will lose 20,400 BTUH of more heat than the home with tight windows.

Another aspect of energy conservation in new or existing homes concerns wall insulation. Wall insulation with a resistance factor of R11 installed in the home described above will reduce heat loss by as much as 10,000 BTUH. Ceiling insulation with a resistance factor of R11 will reduce heat loss by 4,400 BTUH compared to insulation with a resistance factor of R7.

The average heat loss per single family detached dwelling in the mid-temperature regions of the nation is roughly 100,000 BTUH. Ralph Johnson of the NAHB predicted in the April, 1974 issue of the Lumber Co-operator that future home designs will reduce heat loss, on the average, to 50,000 BTUH. The author also predicts that single family detached dwellings will not be constructed in the future.

### The Need for Incentives to Encourage Energy Conservation Construction and Retrofitting.

Presently, financial institutions as well as federal and state agencies do not encourage energy conservation in existing or new buildings in Maine. There are several reasons for the lack of financial incentives to encourage energy conservation in new and older structures which are listed as follows:

1. High construction costs and high interest rates for private bank capital.
2. A lack of federal or state low-cost construction capital.
3. Lack of capital for energy conserving non-conventional homes.

1. High construction and high capital costs. According to Mr. Ralph Gelder, Commissioner of the Business Regulation, the United States and Maine are "built into high rates" which makes home construction and home purchase loans too costly for most people in the State. Mr. Gelder further points out that Maine bankers predict that in five years no more single family dwellings will be constructed in the State.

High interest rates are the result of the rapid rate of inflation and not the result of legal restrictions on Maine's financial institutions. The only restrictions regarding bank loans, Mr. Gelder points out, concerns the ratio of loans to funds on deposit which he considers to be permissive and not restrictive. Present law provides that a maximum of 10 per cent of the funds on deposit in a bank may be used for separate home improvement mortgages.

2. Lack of federal and state low cost construction capital. Federal and State agencies either provide capital for home construction and home improvements through private banks or the agencies insure bank loans. In either case, there is no reduction affected in the interest rates.

Federal and state funds for home construction, home purchase, and home improvement loans, such as the Farmers Home Loans, the Federal Housing Administration loans, the Veterans' Administration loans, and the Maine Housing Authority loans are secured by private bank capital up to 125 or 150 per cent and issued through the banks. Since bank capital is "tied up" as collateral to secure the loans and cannot be invested for income, federal and state monies are loaned to individuals at relatively high rates in order to provide the banks with the income that they deem necessary for their operation.

The Maine State Housing Authority, (MHA) for example, plans to issue up to \$20,000,000 of tax-exempt bonds that are not state obligations for home construction and home improvement loans. According to MHA officials, Maine banks will pledge their collateral to secure the bonds and will extend loans to the public. Since the bonds are tax-exempt, the loans can be issued at a lower rate than most other loans, and the rate at which the public can obtain the loans will be 9 per cent. An interest rate of 9 per cent, however, makes capital costs very high.

Federal Agencies such as the FHA often times guarantee bank loans. Despite FHA guarantees, such loans are as costly as unsecured loans. The banks point out that the capital costs of providing secured and unsecured loans are the same. As a result, the interest rate of a federally-secured loan cannot be reduced because the costs of the capital for the bank is not less.

The federal government will be providing for energy conservation to states which have adopted the ASHRAE 90-P Standard, but the funds are not available for housing loans.

Despite federal guaranteed loans for or participation in the housing market via the private banking community, the participation rate of some federal agencies is very limited.

The Farmers Home Loan Administration (FHL) has been far more active in the Maine housing market than the Federal Housing Administration. Presently, the FHL is loaning more money for home construction and home purchases than it did one year ago. The reason for increased FHL activity in the Maine housing market is the interest credit program of the agency.

The extent of the interest credit program is to provide supplemental credit for low income people. The FHL reduces the interest rate to 1 per cent to the eligible participant and pays the difference to the bank.

While the investment credit program is responsible for the great increase in FHL participation in the Maine housing market, the Agency is not necessarily adding substantially more funds for home purchases or home construction. The amount of capital for home construction and home purchases remains at the same level as it was previously. The additional funds are used to pay interest costs for low income families.

The Farmers Home Loan Administration will provide funds for home improvements which include energy conservation measures. The interest rate, however, is the same for energy improvements as it is for other types of improvements which may be energy losing.

3. Lack of capital for energy conserving, non-conventional homes.

Homes constructed to conserve energy and designed in non-traditional styles such as solar-heated homes, for the most part, cannot obtain public or private financing. Since the federal government issues funds secured by banks or guarantees private bank loans, the bank lending policy prevails. Generally, the banks are concerned about the resale value and marketability of property. Most bankers consider non-traditional style homes to have a low resale value and poor marketability. As a result, energy conserving homes constructed along "modernistic" lines are often times constructed without bank loans.

Federal officials, such as the Veterans Administration and the Federal Housing Administration spokesmen, point out that the federal agencies

are also concerned about the resale value of homes for which they loan funds or guarantee the mortgage. Not only are the federal agencies concerned about home design as an indication of the marketability of homes, the agencies also consider the neighborhoods of the homes they finance in their evaluation. For example, a home designed to conserve energy or an existing home retrofitted to reduce energy use, cannot obtain federal or private bank funds if the homes are located in neighborhoods in which the resale value of the energy conserving homes is greater than the other homes in the neighborhood.

Incentives to Promote Energy Conservation in New and Older Structures.

There are a number of incentives that can be used to promote the construction of energy conserving structures and the retrofitting of existing structures.

1. An energy code. A state-wide building or energy conservation code based on a performance standard would reduce energy consumption. Adoption

of some features of an energy code would also help reduce energy consumption in Maine. An energy or building code, however, may generate opposition from small contractors and local building inspectors who would find it difficult to meet or understand the code.

According to the American Institute of Architects, retrofitting 7 per cent of the existing structures in the United States annually, with energy conserving features and building all new structures to be energy efficient would save 4.65 billion barrels of oil with the first 5 years.

2. Income tax credit. An income tax credit on a percentage to encourage home owners to insulate. Income tax credit -- like a circuit breaker so that low income people might be encouraged to invest in insulation if on presentation of affidavit from supplier that they had purchased insulation attached to their return they would get a percentage of the cost as a tax rebate according to their income bracket, -- or tax credit for percentage of cost of insulation, etc. materials.

Disadvantages

- A. Doesn't give individuals the capital, i.e. cash in the pocket, to make purchase.
- B. State income tax amounts paid by people in low and middle income levels are very small (\$10 - \$110) for a family of five earning \$7,000 - \$13,950; and the tax credits would also necessarily be small and probably not cover the capital investment necessary to reimburse the minimum estimated costs of retrofitting the average home (\$200.00).
- C. There is difficulty in estimating the cost to the State because there is no breakdown of insulation material as

a share of the building supply sales in the State.

In addition, there is no way to estimate the number of people who would take advantage of the opportunity.

- D. The estimated 60,000 low income or indigent home owners probably pay no income tax now, so it would be no incentive for them.

Advantages

- A. This method might encourage high-income owners of rental property to retrofit their apartments and buildings, etc.

3. Exemption of solar equipment and other alternative energy heat source equipment from sales tax and insulating materials.

Disadvantages

- A. The savings on equipment and insulation other than solar equipment would be quite small (\$10 - \$25) and probably not too great an incentive.

- B. No way to estimate cost to the State as in "C" above.

Advantages

- A. Considerable savings (\$375 - \$1,400 in sales tax) might be realized by purchaser of solar equipment ranging in cost from \$7,500 to \$30,000. However, persons not affording these systems probably would not be induced to purchase because of the sales tax savings.

4. Tax heating fuel, used in excess of a standard established to maintain a home with a certain number of cubic feet at a certain temperature for the degree days in their locality; revenue paid into a fund to retrofit the homes of low income and indigent individuals.

Disadvantages

- A. Might be difficult to administer through heating fuel companies. Probably have to reimburse them to some extent for cost of collection, etc.
- B. Another tax.

Advantages

- A. Would help conserve energy.
- B. Would provide the revenue to retrofit the homes of low income families, thereby reducing their fuel consumption.
- C. People who waste energy will pay to reward reduced energy use on a state-wide basis.

5. Direct state loans at cost of money plus cost of administration or state subsidized bank loans to accomplish same result.

Disadvantages

- A. Opposition from banking community.
- B. Difficulty in estimating cost, i.e. number and amount of loans.

Advantages

- A. Could be funded by existing State Housing Authority bond sale authorization.
- B. Could be funded by revenues from taxation described in 4.
- C. Puts capital in hands of consumer when he needs it.
- D. Could be repayed in extended payments equal in amount to the savings in fuel costs resulting from retrofitting homes.

6. Required performance standard for new construction, limiting fuel consumption to 40 BTU/sq. ft./hr.

Disadvantages

- A. The public would have to make choice between windows, glass doors, their location and other design features.

Advantages

- A. All new construction would use the minimum fuel method to keep the home comfortably heated.
- B. Cheaper construction cost.
- C. Uniformly applied.
- D. Easy to administer and enforce.
- E. Easy to comply with.
- F. No restriction on style of house.
- G. By reducing fuel costs, makes increased money available for mortgage repayment therefore reduced risk to bank, etc

7. Require all newly constructed state buildings to conform to a similar kind of performance standard for commercial or multi-use buildings.

Disadvantages & Advantages similar to those listed in 6. above.

8. Education program.

- A. mobile instructional unit.
- B. Recommendations to:
  - 1. State Housing Authority.
  - 2. Vocational parochial schools
  - 3. Health and welfare.
  - 4. Department of Education and Cultural Services.

5. Bureau of Public Improvements.

6. All other state agencies to cooperate in establishing educational programs for their constituents, employees and the public on how energy can be conserved.

9. Provide for utility managed residential ceiling insulation program to conserve heating fuel.

Disadvantages

A. Private utility companies carrying out state policy. However, this is not a new approach. A charge to cover costs could be permitted.

Advantages

- A. Would reach virtually every household in Maine.
- B. Would diversify heating and utility companies into insulation field or,
- C. Encourage private contractors in that type of business.
- D. Easily administered through presently existing accounts.
- E. Easily monitor savings and costs for data bank.
- F. Can be financed through presently existing accounts; cost savings in full applied to cost of insulation.

10. A lower rate permitted or mandated for fuel to homes that have insulated etc., a higher rate for uninsulated homes.

Disadvantages

- A. Persons might not have capital to invest in insulating.
- B. Penalized for circumstances that they can't control.

Advantages

- A. Burden on persons using excessive amounts of fuel.

11. Require insulation up to a particular standard before a preferential electric heating rate can be given to a customer by the utility.

Disadvantages

A. Possible absence of capital on part of customer.

This could be financed by company however as in 9 above.

Advantages

A. This would result in reduced energy demand.

12. Adoption of state building code.

CONCLUSION

The Joint Standing Committee on Energy concluded that no meaningful legislation can be recommended to produce energy conserving structures in the State. The 12 alternatives studies by the Committee would either require substantial State expenditures or the effect of the alternatives would be too minimal to warrant their implementation. For example, adoption of the ASHRAE 90-P Code would cost nearly \$1,000,000 to implement. A Statewide building code, such as the BOCA Code, does not contain any energy conservation requirements. As a result, mandating the BOCA Code as the State building code cannot be justified.

Other alternatives such as income tax credits or sales tax exemption for voluntary conservation efforts do not provide much incentive. An income tax credit, for example, would have to be very minimal because income tax revenues are extremely low. Furthermore, the elderly and poor for whom an income tax credit would be designed would not benefit from such legislation because these people do not pay much in income taxes. A sales tax exemption for insulation costing \$250 would incur a saving of \$12.50 which is minimal. In addition, the current budget situation makes tax reductions and exemptions improbable.

APPENDIX

NEW YORK METROPOLITAN REGION  
RETROFIT FUEL-INSULATION COST FACTORS

Fuel	Actual Cost (\$)	Cost per 100,000 Btu delivered (\$, to nearest .05)	Fuel-Insulation cost factor (\$)
Natural gas	.21/therm*	.30 (at 70% efficiency)	.23
	.32/therm	.45	.35
No. 2 oil	.30/gal.	.30 (at 70% efficiency)	.23
	.44/gal.	.45	.35
Resistance heating	.02/kWh	.60 (at 100% efficiency)	.46
	.03/kWh	.90	.69
	.04/kWh	1.15	.88
	.045/kWh	1.30	1.00

\*1 therm = 100,000 Btu.

OPTIMAL ENERGY CONSERVATION COMBINATIONS  
5,000 Degree Days; 650 Cooling Hours; 20 Year Life

ELEMENT	ATTIC						WALL		FLOOR <sup>5</sup>		FUEL INSULATION COST FACTOR		STORM WINDOWS <sup>6</sup>	STORM DOORS <sup>7</sup>
	None			R-11 <sup>1</sup>			None		None	R-11 <sup>1</sup>	Heating	Cooling		
Existing Insulation	A <sup>2</sup>	B <sup>3</sup>	C <sup>4</sup>	A	B	C	B	C	B					
Material Used														
1 Additional Inches (Years to Pay Back)	10" (4)	10" (3)	6" (3)	5" (14)	6" (11)	3" (14)	3.5" (2)	3.5" (9)	5" (5)	2" (18)	\$ .30	\$ .45	2' x 3' (7)	0 (0)
2 Additional Inches (Years to Pay Back)	12" (4)	11" (3)	8" (3)	7" (11)	6" (8)	5" (11)	3.5" (2)	3.5" (6)	10" (5)	4" (12)	<u>\$ .45</u>	\$ .45	2' x 2' (5)	0 (0)
3 Additional Inches (Years to Pay Back)	13" (3)	12" (3)	9" (3)	8" (9)	8" (9)	6" (9)	3.5" (2)	3.5" (5)	8" (4)	5" (10)	\$ .60	\$ .45	2' x 2' (4)	0 (0)
4 Additional Inches (Years to Pay Back)	17" (2)	14" (2)	11" (2)	11" (8)	11" (6)	8" (7)	3.5" (1)	3.5" (3)	10" (3)	6" (7)	\$ .90	\$ .60	2' x 2' (3)	x/30% (10)

- Equivalent to 3-1/2" of Glass Fiber Batt/Blanket Insulation.
- A—Loose Fill Glass Fiber (R-2.2 per inch).
- B—Glass Fiber Batt/Blanket (R-3.7 inch) (not applicable to finished walls)
- C—Loose Fill Cellulose Fiber (R-3.7) per inch in attic/R-3.3 per inch in walls.

- Floor over unheated basement, crawlspace or garage.
- Minimum economical size; payback for 3' x 5' storm windows, triple track.
- Refers to minimum glass composition of primary door that makes storm door economical (10 year life).

Example 1, using a typical frame wall of a single family house, relates U to R values and demonstrates the dramatic impact of adding insulation.

Example 1'

	Wall without insulation	Wall with R-11 insulation (about 3½" of batting)
Outer layer (air film, siding, building paper, sheathing)	R-2	R-2
Enclosed air space	R-1	R-0*
Insulation	R-0	R-11
Inner layer of wall (interior wall material, air film)	R-1	R-1
Total	R-4	R-14
Wall heat flow value (U=1/R total)	1/4 = .25	1/14 = .07

\* Air space not credited to insulated wall because it has been replaced by the insulating material.

FIBERGLASS TYPE  
INSULATION COMPARISONS

	<u>Heat Flow, Btu/hr.</u>	
<u>Ceiling</u>	1,000 sq. ft. 25 x 20'	(Break even point today 14" insulation)
0"	23,000 Btu/hr	
2"	7,200 Btu/hr	(vapor barrier on warm side)
4"	4,000 Btu/hr	
6"	2,900 Btu/hr	
8"	2,100 Btu/hr	
10"	1,700 Btu/hr	
<u>Wall</u>	1,000 sq. ft.	
0"	18,750 Btu/hr	
2"	6,600 Btu/hr	
3 1/2"	4,720 Btu/hr	
5 1/2"	3,225 Btu/hr	
<u>Windows (movable)</u>	15 sq. ft.	(includes infiltration 19 ft. "crack")
Single	1,580 Btu/hr	
Double	760 Btu/hr	
Triple	500 Btu/hr	
<u>Windows (fixed)</u>	15 sq. ft.	(shows "crack" elimination)
Single	1,280 Btu/hr	
Double	610	
Triple	390	
<u>Doors (outside)</u>	20 sq. ft.	
Single	3,900 Btu/hr	
Storm	2,030 Btu/hr	

floor cellar  
1 sq.'/1500 sq. ft.

THERMAL PROTECTION COSTS

Storm Windows 22-16	\$25 Labor and Materials each
Larger or Irregular	\$30 Labor and Materials each
Storm Doors	\$60 Labor and Materials each
Exterior Steel	\$175 Labor and Materials each
Insulation 6" Ceiling	\$ .40 Labor and Materials square feet
3 1/2" Wall	\$ .20 Labor and Materials square feet