DOE/EIS-0061/DS

U.S. Department of Energy

Office of Conservation and Solar Energy
Office of Buildings and Community Systems
Washington, D.C. 20585

Draft Environmental Impact Statement: Supplement

Energy Performance Standards for New Buildings

March 1980

ERRATA SHEET

Page iii, item (f) should read:

The review period for this supplemental information will end 45 days from the date of publication by the Environmental Protection Agency in the Federal Register of the Notice of Availability of this supplemental information.

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DRAFT ENVIRONMENTAL IMPACT STATEMENT: SUPPLEMENT

DOE/EIS 0061-DS

(a) Lead Agency: The Department of Energy

(b) Proposed Action: Implementation of Energy Performance Standards for New Buildings

(c) For Further Information and additional copies Contact: (1) Mr. James L. Binkley, AIA Office of the Assistant Secretary for Conservation and Solar Energy, U.S. Department of Energy, Rm. GF 231 Forrestal Building, 1000 Independence Ave., S.W., Washington, D.C. 20850, 800-424-9040 or 202-252-2855. (2) Dr. Robert J. Stern, Acting Director, NEPA Affairs Division, Office of the Assistant Secretary for Environment, 1000 Independence Ave., S.W., Room 4G-064, Washington, D.C. 20585, 202-252-4600.

(d) Designation: Draft Environmental Impact Statement: Supplement for Energy Performance Standards for New Buildings (DOE/EIS 0061-DS)

(e) Abstract: Energy performance standards for new buildings are proposed to be implemented as mandated by Congress in Section 305 of the Energy Conservation Standards for New Buildings Act of 1976 (adopted as Title III of the Energy Conservation and Production Act Pub. L. 94-385, 42 U.S.C. 6801 et. seq.) Environmental impacts of setting the Standards were analysed in the Draft Environmental Impact Statement, DOE/EIS-0061-D (DOE 1979a). This supplemental information to the DEIS analyses institutional, socioeconomic and physical environmental impacts of a comprehensive implementation program, which would include adopting, administering, enforcing and monitoring the effectiveness of the Standards. Impacts from four alternative implementation programs designed to bound the range of potential implementation programs have been analyzed as well as impacts of specific components of an implementation program. The range of physical and natural environmental impacts from the four implementation alternatives is within the range of impacts estimated for the Standards.

(f) The review period for this supplemental information to the DEIS ends concurrent with the end of the review period for the DEIS.

EXECUTIVE SUMMARY

1.0 INTRODUCTION

On November 28, 1979 the Department of Energy (DOE) released a Draft Environmental Impact Statement (DEIS) on the proposed rule for the Standards (DOE/EIS-0061-D), which stated that a Supplement to the DEIS would be published to address the impacts of the implementation program since implementation had been presented only as a set of issues. Research has been completed to assess implementation alternatives and their impacts. This research is presented in this Supplemental Information. It focuses on the major findings, areas of known or probable controversy, and issues to be resolved. This Supplemental Information is issued pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.), and the implementing regulations of the Council on Environmental Quality (CEQ 40 CFR Parts 1500-1508) to the fullest extent practicable.

Buildings accounted for one-third of the total energy used in the United States in 1976 (DOE/BCS 1978). Similar findings were reached in an independent analysis by the Harvard Business School using Energy Information Administration (EIA) data, which found that between "36% and 40% of U.S. energy consumption is used to heat, air condition, light and provide hot water for homes, commercial structures, and factories. The residential structure alone uses 20% of all energy used in the United States" (Stobaugh and Yergin 1979). Almost 40% of the energy used in buildings was wasted (DOE/BCS 1978). "In the very near future, substantial savings (of energy) can be made by relatively simple changes in the way we manage energy use...the most substantial conservation opportunities...will be fully achievable only over the course of two or more decades as the existing capital stock and consumer durables are replaced. There are economically attractive opportunities for such improvements in appliances, automobiles, buildings and industrial processes at today's prices for energy, and as prices rise, these opportunities will multiply" (NAS 1980).

In order to improve the energy performance of new buildings, Section 304 of the Energy Conservation Standards for New Buildings Act of 1976 (Pub. L. 94-385, 42 U.S.C. et seq.) (the Act), as amended by Section 304(a) of the Department of Energy Organization Act of 1977 (Pub. L. 95-91, 42 U.S.C. 7101 et seq.), authorizes DOE to develop energy performance standards (the Standards) for new buildings, which are to be implemented at the state and local levels through building codes and other construction control mechanisms requiring equivalent levels of energy conservation. Memorandums of Understanding between Department of Housing and Urban Development (HUD) and DOE (March 1, 1979; January 11, 1980) convey responsibility from HUD to DOE for development of the rule and any required technical support documents for implementing the

Standards.* DOE will assist HUD by planning, managing, and completing analysis and by preparing a draft implementation regulation which may be used by HUD to meet HUD's responsibilities under Sections 305, 308, and 311(4) of the Act.

The proposed action to implement the Standards will consist of developing and promulgating implementation regulations for the Standards pursuant to the Act. Section 302 of the Act indicates that compliance with the Standards should be achieved through existing building codes and other construction control mechanisms or through a special approval process, but with a minimum of Federal interference in state and local transactions. Section 305 of the Act provides that "no Federal financial assistance shall be made available for the construction of any new commercial or residential building in any area of any state" unless certain actions are taken by the state and local governments to avoid imposition of the sanction. However, each House of Congress must approve the need for the sanction before the sanction becomes effective.

2.0 MAJOR FINDINGS

First, the overall environmental impacts are positive. The major areas of concern would be with institutional impacts. The implementation program would need to be designed to mitigate impacts on local jurisdictions and design professionals. The socioeconomic impacts on all groups are small and positive and thus present little concern for the design of an implementation program. The energy savings and attendant pollutant reductions are positive enough to outweigh any negative first costs of building construction, implementation program costs, additional pollutants from increased production of energy-conserving materials, and commitments of human and natural resources.

Second, the Standards are projected to increase a building's purchase price via the increased cost of energy-conserving materials and installation labor. Studies indicate that, in the short run, consumers may be unwilling to bear all of the increase in first costs for the improvement in building energy efficiency that would result from the Standards. Thus, the Standards could cause a slight decrease in building demand and a slight increase in the value of buildings that do not comply with the Standards. Incentives of grants, technical assistance, and related public information can alleviate this short-run reluctance to pay for the improvement in building energy efficiency due

*DOE has assumed, for the purpose of preparing this document, that currently proposed legislation to transfer the authority for implementing the Standards from HUD to DOE will be approved by Congress. If this transfer is not approved then HUD will propose the regulations to implement the Standards. This supplemental information accurately analyzes HUD's desired action should they become the Federal agency to implement the Standards.

to the Standards. These types of incentives would serve to mitigate these short-run impacts. In the long run, as consumers become more familiar with buildings that comply with the Standards, the benefits of improved building energy efficiency would be better understood. Thus, in the long run, consumers are expected to become more willing to pay the increased first cost for the building's improved energy efficiency that would result from the Standards. During this time frame, demand for new housing would not decrease and, in the long run, may increase as a result of the Standards.

Third, the costs and benefits of implementing the Standards will have a small positive impact on the national economy. The costs and savings, although significant, are extremely small compared to the gross national product for any given year.

Fourth, implementation costs for all four alternatives studied were found to be small relative to the value of energy saved and construction modifications. In terms of the cost of energy saved, total implementation costs amount to a one-time cost of a fraction of a cent to a few pennies per million Btu saved, depending on the implementation alternative. On this basis, additional first costs of construction range between $1 and $2 per million Btu saved, depending on the type of fuel, climate region, and assumed building life time. For most regions, this is considerably less than the price of the fuel being saved. Implementation costs for the alternatives were calculated to include implementation and administrative actions that would be required at the Federal, state, and local levels.

Fifth, a multi-path implementation program (i.e., one that includes both a certification process and an Alternate Approved Process (AAP)) that includes both incentives and sanctions may induce maximum compliance with the Standards.

In summary, the Standards would enhance energy savings over and above the market place, no matter what type of implementation program were chosen, although major energy savings depend on the extent of enforcement at the local level. The negative physical, institutional, and socioeconomic impacts are small compared to the cumulative energy savings estimated to result from the four implementation programs analyzed.

2.1 INSTITUTIONAL

The analysis of institutional impacts of implementing the Standards yielded several major findings. First, state and local jurisdictions with building or energy codes will be able to adopt a new code more readily than jurisdictions with no code experience. Forty-two (42) states currently have adopted some form of an energy code. However, it is unlikely that state and local jurisdictions will amend existing codes until Federal grants are made available, since jurisdictions

generally tend to view the cost of revising existing codes to be greater than the benefits. Thus, if no incentives are provided to localjurisdictions and a multiple compliance path (i.e., a certification process and an AAP) is available, jurisdictions would probably choose the AAP. The majority of states and localities may choose to develop, implement, and administer an AAP in the initial stages of an implementation program and thus avoid the imposition of sanctions. States and local jurisdictions would consider several factors when deciding whether to comply via a certification process or an AAP. These include:

- o time and cost to revise an existing code
- o time and cost in code qualification
- o program requirements for implementing, administering, enforcing and monitoring
- o local political climate toward code adoption
- o legislative action required for code adoption
- o availability of Federal incentives and implementation tools.

Second, code adoption does not ensure, in and of itself, code enforcement. Analyses suggest that under any type of implementation program the level of enforcement will vary among states, within states, and perhaps within local jurisdictions. Most state governments are not likely to assume responsibility for local enforcement and monitoring activities. Since some states do not require local jurisdictions to enforce codes, some of these jurisdictions have avoided doing so. Thus, an effective implementation program would need to require state and local jurisdictions to administer, enforce, and monitor the codes in order for them to receive incentives or to avoid the sanction.

Third, the level of responsibility for enforcement will depend upon the actions taken by the Federal government to encourage compliance. The key action which will encourage compliance is the granting of incentives and possibly the imposition of sanctions. With sanctions and no incentives, Federal government responsibility for enforcement is greater than state or local responsibility. With sanctions and incentives, responsibility for implementation remains at the Federal level, but the majority of enforcement responsibilities shifts to the state and local level.

Fourth, the most cost-effective application of grants to state and local governments would be to provide incentives to states that have high demand for new construction, because greater energy savings would result if the incentives resulted in those states adopting and enforcing the Standards. Twenty-eight states would be covered by this definition (see Chapter 5). High demand is interpreted to include both the level of building activity and the rate of growth. However, it may be impossible to induce some states to comply through the adoption of a code, no matter how many incentives are provided.

Fifth, implementation, administration, and enforcement of the Standards for Federal buildings can be accomplished through either a decentralized or centralized implementation program. Whether Federal agencies enforce the Standards for Federal buildings in a centralized or decentralized way will determine how Federal compliance will affect implementation. Centralized enforcement responsibility for Federal buildings in one Federal agency would have at least two potential impacts. One, other Federal agencies may resist relinquishing authority over one aspect of their new buildings to another agency. And two, although centralized authority may result in a higher level of actual compliance, it would probably increase Federal paperwork and thus delay those agencies constructing new buildings.

2.2 SOCIOECONOMIC

For the national economy, the Standards would have a small positive impact on employment, income, gross national product, and building construction.

The Standards would increase the first cost of new residential housing by approximately 2% and increase the cost of new commercial buildings by $0.80/sq. ft. In the short run, consumers might not be willing to pay the increase in first cost for improved building energy efficiency that would result from the Standards. Thus, in the short run, this increase in building cost may cause a slight decrease in building starts and a slight increase in the value of houses that do not comply with the Standards.

Calculations of net present value show that with full information the consumer's benefits from implementing the Standards should exceed the cost of energy-conserving materials and installation labor for most building types. The payback period for the investment ranges from 3 to 10 years. A payback period is the time required for benefits of energy savings to outweigh the cost of the investment in the building. In the long run, information on the benefits of improved building energy efficiency due to the Standards should circulate among consumers. Thus, in the long run housing starts will not decrease as a result of the Standards and, in fact, may increase slightly.

The Standards are expected to have some equity implications. First, some consumers, especially those from lower income groups, would perceive less benefits from the Standards than other consumers, because consumers have different time preferences for money. That is, some consumers would be willing to trade off more future income for present income than other consumers. Consumers who value present income higher than the average consumer relative to future income would derive less benefit from the Standards.

Second, it is possible that the small increase in first costs will cause a small number of consumers to be priced out of the new buildings market. This impact would be expected to occur more frequently among lower income groups but could be mitigated either through tax incentives or through incorporating energy efficiency into lending institutions' decisions.

Third, tax credits and deductions would result in some equity impacts. The tax credit or deduction could prevent any one from being priced out of the new building market, except the consumer who did not pay any taxes. Also, a tax incentive would cause an income transfer from society to purchasers of new buildings. Tax credits are not an available option under the Act, and thus would require legislative change in order to become part of the proposed action.

The regional impacts of the Standards on earnings and employment are expected to be small and positive. The only regions in which this would not hold true are those that produce a large percentage of the Nation's building energy conservation materials, where more positive economic results would be experienced.

2.3 PHYSICAL ENVIRONMENT

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The full range of physical environmental impacts was handled by the Draft Environmental Impact Statement (DOE/EIS 0061-1) released in November of 1977 and is not changed in scope by the implementation alternatives. The impacts of the Standards on man's physical environment are projected to be positive for all implementation alternatives. For each alternative, energy consumption is reduced and pollutant releases associated with energy consumption are correspondingly reduced. The extent of the positive impacts is a function of the penetration rates for each implementation alternative. That is, the greater the penetration occurring as a result of the implementation strategy, the greater the positive impact.

3.0 ISSUES AND AREAS OF PROBABLE CONTROVERSY

Several issues have been identified that represent major questions for decisionmakers. First is the question of whether the implementation program should include sanctions. The inclusion of sanctions may increase the effectiveness of the program but also exacerbate the possible impacts of the program. This document has included sanctions in the proposed Federal program, however it is recognized that this needs to be considered carefully before a final decision is made.

Second are issues related to including incentives in the implementation program. Namely, should there be incentives at all, and, if so, to what

groups should these be targeted, and at what levels? If the building purchaser benefits from the Standards, it could be argued that to provide incentives to market participants would be wasteful of tax monies. However, incentives to market participants judiciously applied could serve to speed the acceptance and implementation of the Standards. The form and extent of incentives provided to design professionals and to state and local governments also must be decided.

Third is the issue of the effectiveness of the Standards and the implementation program. Some parties might argue that the economic pressure of increasing fuel prices would result in savings nearly as large as those from the Standards. The analysis in support of the Standards shows savings beyond those accruing from market forces. A related issue is whether to update the Standards, and if so, how often.

Fourth, the timing of preparation of implementation tools is critical. The elements of the implementation program must be available to design professionals and local jurisdictions no later than 1 year after the promulgation of the Standards for the Standards to be most effective.

4.0 IMPLEMENTATION ALTERNATIVES

Alternative implementation programs, including an alternative which represents no action beyond promulgation of the Standards, have been analyzed and their impacts compared. Many implementation components are available from which to develop an implementation program consistent with the Act. An implementation program consists of three major elements: ways to comply with the Standards, actions to encourage compliance, and tools to encourage compliance.

Because the number of possible implementation programs was too numerous to be presented as individual alternatives, a bounding set of alternative scenarios was developed and analyzed. The bounding set of alternatives provides a range of extremes for an implementation program. One extreme would be to have no implementation program; the other extreme would be to implement a mandatory program with sanctions and no incentives.

Four alternatives are analyzed. Alternative 1, No Sanctions-No Incentives, represents the no action alternative, which continues present building energy conservation trends. This alternative assumes that the Standards will be promulgated without any attempt by the Federal government to provide any implementation program. Alternative 2, No Sanctions-Incentives, represents a voluntary implementation program that provides incentives to achieve compliance. Alternative 3, Sanctions-Incentives, is a mandatory program that provides incentives to achieve compliance and to mitigate negative impacts caused by the sanctions. Alternative 4, Sanctions-No Incentives, represents the most stringent approach for an implementation program. It requires all affected parties to comply with the Federal government's program. The

Federal government would provide tools to encourage compliance but would not provide incentives to mitigate the impacts. Impacts by implementation program components, are compared. Impacts from the various alternatives can be related to the effects of, for example, the provision of sanctions alone or incentives alone or both together. This allows for an assessment of implementation program components, their potential variations, their impacts, their interrelationships, and their effectiveness in achieving compliance.

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1.0 INTRODUCTION

This document is issued as supplemental information to the Draft Environmental Impact Statement (DEIS) on the proposed rulemaking for the Energy Performance Standards for New Buildings published in November 1979 (DOE 1979a). The purpose of this document is to examine the alternative methods of implementing the performance standards (the Standards) and their impacts on the human and natural environment. The document thus analyzes institutional, socioeconomic, and physical environmental impacts of implementing the Standards.

Buildings account for nearly one-third of the total energy used in the United States. Residential buildings account for approximately 20% and commercial buildings account for 13% of the Nation's annual energy consumption. A recent study has shown that 40% of the energy used to operate and maintain buildings is lost through poor design, inadequately insulated walls, ceilings and basements, poorly designed and operated equipment, and poor maintenance (DOE/BCS 1978, Stobaugh and Yergin 1979). It has been estimated that 21 to 51% of the residential energy and 17 to 52% of the multifamily and commercial energy (HUD 1978, DOE 1979b) could be conserved in new buildings by more energy-conserving designs. Congress enacted the Energy Conservation Standards for New Buildings Act of 1976 (the Act), Title III of the Energy Conservation and Production Act (Pub. L. 94-385, 42 U.S.C. 6831-6840) to develop and implement energy performance standards for residential and commercial buildings to reduce this loss of energy and to achieve the maximum practicable improvements in energy efficiency in newly constructed buildings.

The Act directed the Department of Housing and Urban Development (HUD) to develop and promulgate energy performance standards for new buildings and to undertake the implementation of these standards. The Department of Energy Organization Act (Pub. L. 95-91, 42 U.S.C. 7101 et seq.) of 1977 transferred the responsibility and authority for development and promulgation of the Standards from HUD to the Department of Energy (DOE). DOE issued its Notice of Proposed Rulemaking (NOPR) for the Standards on November 28, 1979. Memorandums of Understanding between HUD and DOE (March 1, 1979; January 11, 1980) conveyed the responsibility for development of implementation regulations for the Standards from HUD to DOE. DOE will assist HUD by planning, managing, and completing analysis and by preparing a draft implementation regulation which may be used by HUD to meet HUD's responsibilities under Sections 305, 308, and 311(4) of the Act.*

*DOE has assumed, for the purpose of preparing this document, that currently proposed legislation to transfer the authority for implementing the Standards from HUD to DOE will be approved by Congress. If this transfer is not approved then HUD will propose the regulations to implement the Standards. This supplemental information accurately analyzes HUD's desired action should they become the Federal agency to implement the Standards.

Section 302 of the Act indicates that compliance with the Standards should be achieved through existing state and local building codes and other similar construction control mechanisms or through a special approval process, but with a minimum of Federal interference in state and local transactions. Section 305 of the Act provides for the sanction that "no Federal financial assistance shall be made available for the construction of any new commercial or residential building in any area of any state" unless state and local governments take action to implement the Standards or receive an exemption from implementing the Standards pursuant to appropriate Federal regulations. This sanction may not be implemented without approval from each House of Congress.

This Document examines the environmental impacts of alternative methods of implementing the Standards as required by the procedures of the National Environmental Policy Action (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.) and the implementing regulations of the Council on Environmental Quality (CEQ, 40 CFR Parts 1500-1508) to the fullest extent practicable.

Although rules for implementing the Standards have not been formally proposed at this time, this Supplement describes a range of alternative implementation actions, identifies the components of an implementation program and analyzes the impacts of implementation alternatives on the institutional, socioeconomic, and physical environment. The institutional section assesses the impacts of Federal actions on other Federal agencies, state and local governments, and building industry groups. The socioeconomic section assesses the impacts on industry, employment, and the consumer. The physical environmental section assesses the impacts on energy consumption and the natural and human environment.

2.0 DESCRIPTION OF PROPOSED ACTION

The proposed action to implement the Standards consists of developing and promulgating a regulation which incorporates both Federal incentives and sanctions. The objective of the implementation program is to achieve widespread use of the Standards so that new residential and commercial buildings will be designed and built with Design Energy Consumptions equal to or less than the Design Energy Budgets for each building type (DOE 1979b). State and local governments will be instrumental in achieving this objective through the adoption and implementation of building codes and other construction control mechanisms or through an Alternate Approval Process which complies with the implementation regulations.

The Act requires all new commercial and residential buildings to be designed so as to conform with the Standards unless the specific area in which the building is being built has been exempted (Section 305(a)(3)). The Act further authorizes the sanction of witholding Federal financial assistance from areas where the construction of any new commercial or residential building does not meet the requirements of the Standards to be withheld (Section 305(a)). However, the application of sanctions is subject to approval by Congress before they can be incorporated as part of the implementation program. Additionally, the Act permits a number of incentives such as grants and technical assistance programs to encourage and assist compliance with the Standards (Section 307 and 308 of the Act).

There will be two different ways for states or local governments to comply with the Standards:

- Certification Process
- Alternate Approval Process

The key roles in the certification process will be played by states who will certify that energy-conserving codes have been adopted and are being implemented, and by local government bodies who will be enforcing these energy codes. For those areas that do not have building codes, energy codes or are otherwise unwilling to adopt and enforce one, an Alternate Approval Process (AAP) is available. Whereas the certification process requires that jurisdictions adopt and enforce a code equivalent to the Standards, the AAP requires that the building design be evaluated by an approved design professional to measure potential energy consumption of the proposed building regardless of whether the local jurisdiction has adopted a code.

Because practically every energy code or standard used nationally is a prescriptive or component type, DOE is developing, and will make available in Appendix III and IV of the Final Rulemaking of the Standards, equivalent component and prescriptive codes to encourage the implementation of energy conservation in buildings. The types of codes and

standards contemplated for the equivalency sections of the regulations include a revision of the HUD and Farmer's Home Administration (FmHA) Minimum Property Standards (MPS) for residential construction; an ASHRAE-type code for commercial buildings; a revision of the Model Code for Energy Conservation (MCEC); and several other nationally recognized codes and standards. A complete list of tools to encourage compliance including these proposed revisions, equivalency methodologies and manuals of recommended practice can be found in Chapter 3 of this document. Most of these can be used in both the certification process and AAP.

Where it is not practicable for state or local governments to comply with the Standards, a method for obtaining exemptions from the provisions of the Sanctions will be proposed.

2.1 CERTIFICATION PROCESS

The implementation regulations will set forth criteria by which a state can certify that its code or the codes of its units of general purpose local government are "equivalent" to the Standards and are being implemented and enforced.

A code may be considered equivalent if the buildings designed to that code have Design Energy Consumptions equal to or less than the Design Energy Budgets permitted for that building type within the Standards. This can be determined in a number of different ways: the language of the code may reflect that the Standards themselves have been adopted; the code may be identical to one of the model codes or standards listed in Appendix IV of the Regulation; or the methodology made available by DOE in Appendix III for evaluating the equivalence of a code may be utilized.

To establish that a particular code has been properly adopted and is being adequately implemented, a state will have to submit information required by the Secretary. This type of information will include documentation showing:

1. an equivalent code(s) has been adopted,

2. the name(s) and address(es) of the state or local code enforcement agencies,

3. a code citation requiring that no permit allowing construction or occupancy be issued unless the design is in compliance with the building energy code,

4. requirements for regular inspections to determine that buildings are being constructed in conformance with approved designs,

5. a provision requiring that designs for buildings over a certain designated size be evaluated using the performance approach,

6. provisions for handling local and state amendments to certified codes.

Under the certification process the state would be responsible for ensuring that state and local building code departments bring new commercial and residential buildings into compliance with the Standards.

2.2 ALTERNATE APPROVAL PROCESS

The AAP is a method of compliance which requires a local enforcement official or a design professional to determine whether the design complies and an affidavit from the builder that the structure will be built to that design. The enforcement agency would receive and file the determination and affidavit in order to make a declaration that the building is designed and built to meet or exceed the Standards. The declaration would be used, by a person seeking construction funds, to signify to lending institutions that financial assistance can be given. The declaration is then collected and filed at the lending institution.

The local agency responsible for administering this AAP is specified by the Act. Section 305(b)(4) states that the agencies administering this process in order of priority will be the building permit-issuing office or the agency established to oversee the building process at the local government level or, if none of the above are able or willing, any agency of the state willing or able to administer this process.

It is anticipated that the AAP would be utilized more frequently for compliance with the Standards than the certification process during the period immediately following the effective date of the Standards, mainly because of the time required to amend a state or local code to make it equivalent with the Standards and the minimal amount of increased administration required by the local government.

The administering agency will be required to grant a declaration to an applicant indicating that the administrative requirements of the Standards have been met. These include:

1. a statement by the jurisdiction that the agency has the authority to administer the design approval process

2. a statement by the jurisdiction that a copy of the building design and the determination that the building meets the Standards are on file,

3. a statement by the jurisdiction that a written assurance is on file from the builder or the person applying for the declaration, which affirms that the construction of the building will conform to the approved design and that, should substantial modifications occur during construction, a new design will be submitted for approval.

To avoid the sanction, an applicant for construction funds will present this declaration to a lending institution or other appropriate Federal agency to show compliance with the Standards.

2.3 SANCTIONS

The Act (Section 305(a)) provides for a sanction of withholding Federal financial assistance for construction of any new commercial or residential building in any area of any state unless the unit of local government or the state complies with the implementation program or the area in which the building is to be built has been determined by the Secretary to be an exempt area .

The Department is currently studying the advantages and disadvantages of specific components of a sanctions program. The results of these studies will be used to develop a recommendation to the President about the timing and nature of a sanction. The act also requires that each House of Congress approve the need for the sanction before it takes effect.

Federal financial assistance is defined in Section 303(3) of the Act as:

1. Any form of loan, grant, guarantee, insurance payment, rebate subsidy, or any other form of direct or indirect Federal assistance (other than general or special revenue sharing or formula grants made to states) approved by any Federal officer or agency; or

2. Any loan made or purchased by any bank, savings and loan association, or similar institution subject to regulation by the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of Currency, the Federal Home Loan Bank Board, the Federal Savings and Loan Insurance Corporation or the National Credit Union Association.

Federal financial institutions will not authorize loans until a state or local code equivalent to the Standards has been adopted and enforced, or a building design has been determined to be in compliance with the Standards through an AAP. Certified jurisdictions will be listed regularly in the Federal Register to notify financial institutions of areas which can receive construction funds. A

jurisdiction not listed in the Federal Register would imply that a design approval process is in place; thus the lender will have to collect a declaration of design compliance and an affidavit from the jurisdiction that the building will be built to that design.

State and local governments which cannot comply may be able to receive an exemption from compliance with the Standards. This exemption can be granted by the Secretary after receiving a request and justifying documentation from the state in which the area is located. Congress recognized in the Act that there may be areas of the Nation where the volume of building construction is so low and building regulatory mechanisms so undeveloped that the approval process or the adoption and implementation of certified codes will be disproportionally costly in relation to benefits expected.

A request for an exemption will have to include data from which a cost-benefit analysis could be performed. The state will be required to estimate the costs of administering an AAP based upon the anticipated levels of construction in the area. These can be subtracted from a dollar estimate of the benefits in energy savings that will be achieved over the same period had buildings been designed in accordance with the Standards. If the balance is negative (i.e., costs exceed benefits), an exemption will be granted.

The regulations will propose not to grant exemptions to an area which is located within code enforcement jurisdictions. The existence of an agency to regulate building inspections in those areas indicates that the level of construction in such an area is sufficiently high to justify the costs of regulation. The Secretary will publish in the Federal Register at regular intervals the names of all jurisdictions that have been exempted from complying with the Act.

2.4 INCENTIVES

Incentive programs that provide grants and technical assistance will be proposed to facilitate implementation of the Standards. Grants and/or technical assistance programs directed at the specific needs of state and local code enforcement officials and design professionals are proposed to assist them in using the implementation tools described in Section 3.1.3. Educational programs for builders, consumer groups and lending institutions may be integrated into the grants or technical assistance programs.

3.0 DESCRIPTION AND IMPACTS OF VARIOUS IMPLEMENTATION ALTERNATIVES

This chapter is divided into five major sections. Section 3.1 describes potential components (i.e., administrative actions, incentives, sanctions, models, codes, grants, etc.) that can be used to develop any implementation alternative. Section 3.2 presents four potential implementation alternatives that were designed to bound the possible range of programs (and therefore the range of potential impacts) that could be implemented. As DOE is currently defining a proposed implementation program, it is possible that the proposed action will not coincide with any of the four alternatives analyzed in this document, although Alternative 3 is closest to the proposed action. Each of the alternatives is composed of a subset of the available or contemplated components described in Section 3.1. The alternatives chosen are Alternative 1, No Sanctions—No Incentives, Alternative 2, No Sanctions--Incentives, Alternative 3, Sanctions--Incentives, and Alternative 4, Sanctions—No Incentives. The remaining three sections present estimates of impacts that would occur under each of these alternatives. Section 3.3 develops expected rates of adoption of the Standards and relates the rate of adoption to the four alternatives. Section 3.4 develops costs to Federal and state and local governments to implement, administer and enforce the Standards under the four alternatives. Costs are estimated for the components that make up each alternative. Finally, Section 3.5 presents a comparative analysis of the institutional, socioeconomic and environmental impacts of the four alternatives.

3.1 DESCRIPTION OF POTENTIAL COMPONENTS OF AN IMPLEMENTATION PROGRAM

The components that could be used to develop an implementation program include:

- Ways to comply with the Standards
- Actions to encourage compliance
- Tools to encourage compliance

Most of the components can be implemented to different degrees. The potential variation in degree of implementation within each component determines the range of impacts associated with each category. Many of these components were derived from interpretation of the statutory requirements in the Act (Pub. L. 94-385).

3.1.1 WAYS TO COMPLY WITH THE STANDARDS

There are several ways for a building to be in compliance with the Standards depending on whether a local jurisdiction has been certified by the state as having adopted and enforced a building code equivalent to the Standards, and whether the building is a Federal building or is built with money from Federally insured housing programs. Three potential ways to comply are described below: 1) Federal compliance, the requirements of which are well defined in the Act, 2) certification process, and 3) Alternate Approval Process, all of which are under development or are being contemplated by DOE. Finally the exemption process is explained in Section 3.1.1.4.

3.1.1.1 FEDERAL COMPLIANCE

Section 252 of NECPA requires that, when the performance Standards under this program are made effective, the energy section of the Minimum Property Standards (MPS) of the Federal Housing Administration (FHA) and the Farmer's Home Administration (FmHA) shall be revised to meet the Standards. Whether DOE would be empowered to approve or disapprove revisions made by the separate agencies or would be limited to providing technical support has not been determined. Even if Congress does not approve the use of the sanction, this provision means that, after the effective date, any new construction subject to MPS (all subsidized and federally insured housing programs) must comply with the Standards.

Section 306 of the Act requires that the head of each Federal agency responsible for the construction of any Federal building shall adopt procedures necessary to assure that any such construction meets or exceeds the Standards. Section 546 of NECPA further provides that energy performance targets be established for construction of Federal buildings that are consistent with the budget levels set pursuant to the Act. These latter provisions apply regardless of whether Congress approves the use of the sanction.

No variation to either of those required Federal actions has been considered since they are both required by statute as stated above. However, Section 306 of the Act is unclear whether enforcement responsibility for Federal buildings should be centralized or reside with the head of the respective agencies. The relative impacts of centralized versus decentralized responsibility are discussed in Section 5.1 under Federal Compliance.

3.1.1.2 CERTIFICATION PROCESS

The Act presently calls for a certification process in which states would be required to certify, pursuant to appropriate regulations, that local units of government have adopted energy codes that meet or exceed the energy budgets set by the Standards and that they are being adequately enforced. To facilitate monitoring the effectiveness of the Standards, the administering agency might require that states send a copy of the findings that led to certification to the Federal government.

Three elements can vary within a certification process. One, the technical criteria for qualifying state and local codes could require that the code be performance-based, component-based or that both bases be provided as options. Two, the required content of the codes could vary within a certification process. And, three, the procedural requirements for code qualification could vary in terms of specifying how to achieve equivalency with the Standards.

3.1.1.3 ALTERNATE APPROVAL PROCESS

The Act permits an Alternate Approval Process (AAP) in jurisdictions where qualified codes do not exist. This type of program would be designed to the specific needs of a state or local government and to evaluate each proposed building design to determine whether it complied with the Standards. These determinations could be made by qualified design professionals whether they be in the private sector or in local government.

The AAP as described in Section 305 of the Act has two requirements. It requires an evaluation of the energy design, and it requires a specified agency of state or local government to issue a declaration that the requirements of the Standards have been met. This declaration permits local jurisdictions to retain their historical control over local building practices but does not burden them with evaluations of potentially complicated energy designs.

This type of program has the advantage of permitting compliance soon after the Standards are promulgated. Citizens in areas of the country where state and local governments have been unable or unwilling to adopt codes would still be able to participate in an energy conservation program for new buildings.

3.1.1.4 UTILITY REGULATION PROGRAM

A regulation program by energy utility companies would specify that a utility not connect a new building to its system unless the building were built in accordance with a design determined to be in compliance with the Standards. These determinations could be made either by the utility company or a qualified design professional who may or may not be affiliated with a state or local code department. The nature of such a program would vary by the type of regulated utility serving each consumer. To affect a large number of consumers, it would have to apply to both inter- and intrastate regulated utilities and to municipal utilities. Municipal and rural cooperative utilities are not regulated by state Public Service Commissions. However, rural cooperative utilities do not serve a large number of buildings affected by this Act.

A utility program could be structured in two ways. Federal regulations could require utilities to either conduct plan reviews and building inspections to ensure compliance with the Standards before providing service to any building, or to receive a declaration of building compliance from an authorized unit of local government in much the same way as would lending institutions in enforcing the sanctions outlined in the Act. Presently, no Federal authority exists which allows utilities to refuse service to customers who do not build energy-efficient structures. Therefore, this approach would require additional legislative authority and that is why we have not considered this type of program for implementing the standards. This type of program would put the burden of compliance on consumers and utilities rather than on state and local governments.

3.1.1.5 EXEMPTIONS

Programs with mandatory requirements nationally applied frequently create burdens that vary in intensity among state and local governments and individuals. The Federal government has the responsibility of relieving an inequitable burden while simultaneously attempting to uniformly apply the Standards.

Exemptions from the requirements of the Act become necessary only if the sanction becomes mandatory. The language of the Act permits a state to grant exemptions to an area where the magnitude of construction is not sufficient to warrant the costs of implementing the Standards (Section 305, (a)(3)). Pursuant to the implementation regulations the state could be asked to provide the name(s) of these areas and justifications for the exemptions. The justification information would probably include an approximate cost to the community, the amount of construction the area has experienced in the last few years and the amount pre-

dicted for the next few years, a description of the local government and its present ability to administer any code program, a description of the level of construction in nearby communities, and any other information the state feels is pertinent. Upon receipt and approval of this information, the Secretary would probably publish the names of the exempt areas in the Federal Register, thereby giving notice to Federal regulatory agencies and their members that the sanction should not be imposed against anyone requesting construction funds for buildings in the exempt area.

Definitions of how to calculate "magnitude of construction" or "cost of implementation" will be provided when implementation regulations are proposed. For now, the cost of implementing the Standards is conceived to be the cost to the local government of administering an AAP. Other types of sanctions would have to provide exemptions tailored to accommodate the needs of those who might be unreasonably burdened by the particular sanction.

3.1.2 ACTIONS TO ENCOURAGE COMPLIANCE

Actions to encourage compliance refer to the driving force within a program which motivates compliance; in this case, the exercise of incentives or sanctions and other program elements including monitoring and updating. This section addresses various incentives and sanctions as means of encouraging compliance with the Standards and the monitoring and updating requirements of the Act.

3.1.2.1 INCENTIVES

The degree to which the Standards are implemented will vary according to the amount and type of incentive provided. Four types of incentives—grants and technical assistance including demonstration programs, tax credits, tax reform, and public information programs--are considered. Such incentives would be directed toward national model code organizations to develop equivalent energy codes, national organizations of design professionals and construction professionals to promote the use of new performance design techniques, state and local code enforcement agencies to adopt and implement energy codes, and the various market participants in the building industry.

o Grants And Technical Assistance

The Act requires that grants and technical assistance be made available to states and localities to assist them in implementation. Grants to local agencies would probably be channeled through the appropriate State Energy or Building Code agency. The size of the grant awarded to a particular state would depend on the amount of new construction in that state, the number of jurisdictions implementing energy codes in compliance with the Standards, and the additional resources necessary for state and local governments to implement them. These grants would be expected to help in promoting the implementation of the Standards in that state and local governments would probably be more able to adopt or revise codes if resources were provided to cover some of the costs of the legal procedures or to educate the appropriate people and increase awareness of energy-related issues.

To qualify for such grants, a state would submit a state implementation plan, which would identify those areas of the state covered by state and local implementation plans, and justifications for those areas exempted. The plan would provide details of: (1) state programs that provide incentives for technical assistance and training to local code jurisdictions, and design and construction professionals, (2) state requirements for certification of local jurisdictions, (3) state programs to monitor local enforcement and building industry compliance with the codes, and (4) state appeal processes. Where appropriate, the plan would specify the funding and staffing available for, and the technical and procedural requirements of, these programs. Finally, the plans would specify local enforcement efforts, including the funding, staffing and procedures for local training assistance, plan review, site inspection, as well as procedures for designer or contractor determination of plan or building compliance with the Standards.

Grants could be provided for the development of model energy codes to achieve equivalency with the Standards, and for model administrative procedures designed to aid state and local governments in the implementation and enforcement of performance and equivalent component standards, if this were determined to be necessary.

The Federal government could provide ongoing technical assistance to state and local code enforcement agencies and the building industry to answer technical questions and solve unique design problems as they arise. Such ongoing technical assistance might be provided by Regional Technical Assistance Centers to be established in each of the ten DOE regional offices, or by Federal financial support of approved technical assistance programs by model code organizations and national organizations of design and construction professionals.

o Demonstration Projects

Federally funded projects could demonstrate how state and local jurisdictions with varying resources and experience with building energy standards could develop programs to successfully adopt, implement, and enforce the Standards. Demonstration projects directed toward the building industry could show how different types of buildings would be designed and constructed in different climatic zones so as to comply with the Standards. These demonstration projects would provide the basis for initial "model" buildings to be included in DOE's "Manual of Recommended Practice," discussed in Section 3.1.3.

Finally, the Federal government could provide technical assistance in the form of ongoing programs, in conjunction with the National Bureau of Standards (NBS) and the National Institute of Building Sciences (NIBS), to test and certify the energy conservation potential of building materials, components, and techniques.

o Tax Credits

A tax credit to consumers would help to create a demand for energy-conserving structures to which builders and designers could respond. Application for this tax credit would be made on forms provided by the Internal Revenue Service. The documentation required for the credit would probably include a copy of a determination of building compliance signed by a qualified member of the appropriate state or local building code enforcement department or a qualified design professional. The life-cycle payback period and the energy savings associated with buildings in compliance with the Standards (DOE 1979c) indicate an economic incentive inherent in the Standards. Large tax credits, therefore, might be viewed as an over-investment in the program.

Tax incentives could also be directed toward design professionals. For example, it is possible to conceive a program in which designers themselves may deduct costs of doing energy analysis. Or, alternatively, the costs of designing a building, which are now treated as capital cost to a building owner for tax purposes, might be made deductible if the designs were determined to be in compliance with the Standards.

o Tax Reform Program

Many energy costs of operating commercial buildings may be deducted from annual income under the present tax structure. This is considered to be a tax disincentive for energy conservation in commercial buildings and leased residential buildings. One way of dealing with this problem is to amend current tax regulations to eliminate this type of deduction. Different tax reform programs to promote the use of the Standards and general energy conservation concepts are currently under consideration.

o Public Information Program

A widespread program of public information and education would encourage builders, consumers, and other market participants in the building industry to make decisions based on minimizing life-cycle costs of new buildings, and thus lead to more energy-efficient new construction. This program could consist of a mass media campaign to publicize the benefits of the Standards and an expansion of the Energy Extension Service to supply information to the general population.

Several informational and educational programs could be provided to building industry participants. First, informational and educational programs directed toward design professionals could be provided to familiarize them with performance-based designs and equivalent standards or codes. Second, informational programs promoting the Standards by emphasizing the costs and benefits of energy-efficiency in relation to life-cycle costs could be directed toward consumers. Third, informational programs might be developed to disseminate information on the energy-efficiency of similar materials and their applications in building design.

3.1.2.2 SANCTIONS

Considerable latitude exists for applying the sanction within the statutory guidelines of Section 305(c). The advisability of implementing different levels of sanctions at different rates is being studied. A specific recommendation will be made to the President when the final Standards are published. Alternative sanctions such as social pressure and use of civil and criminal penalties are also discussed.

o Jawboning

Federal jawboning efforts could range from no action to a large-scale program to publicize the names of jurisdictions not in compliance. This latter option could be part of an overall campaign to publicize the Standards and their benefits.

o Administrative

This sanction could take the form of withholding Federal financial assistance (as discussed in Chapter 2), such as construction program monies, from states and local governments that do not adopt and enforce building energy codes that are equivalent to the Standards. This type of sanction would affect those groups with the legal authority and responsibility of complying with the Standards. This sanction could also be applied by withholding Federal mortgage money unless building designs were found to be in compliance with the Standards. In this case, the sanction would be initially imposed against people who are not directly in control of the building code process.

Additional administrative sanctions could involve amending the licensing requirements of design professionals to include an understanding and demonstration of performance design techniques. This type of sanction might be instituted by state licensing boards.

o Civil And Criminal Sanctions

The strictest type of sanction would include criminal liabilities for noncompliance. The Act does not currently authorize such sanctions. Design professionals who evaluate energy designs may incur a civil liability if those designs do not actually comply with the Standards. Furthermore, builders may incur contract liability where the actual building has not been built to the approved or certified design.

3.1.2.3 MONITORING AND UPDATING

The Federal monitoring and Congressional reporting requirements on the status of state and local energy code adoption and enforcement would be required by the administering agency as specified in the Act. Information on state and local activities in energy conservation in new buildings would be reported to Congress in the same manner that is currently being used by DOE and other agencies.

Federal monitoring could take a number of forms. First, the Federal government could collect information provided directly by designers, states or localities. Whenever possible, this information would be required on applications for obtaining and extending monetary incentives, for technical assistance, grants, and so on. Such information would include: the legal organizational arrangements available to adopt and enforce codes at the state and local level; the amount of state and local resources devoted to code adoption and enforcement; the use of Federal incentives, such as the number and type of training seminars held, the number of local code officials retained, and the number of building permits issued by type and jurisdiction. In addition, the Federal government might conduct spot checks. These could consist of direct monitoring of state and local plan reviews and designer determinations, evaluation of actual building designs to ensure compliance with the adopted code, and monitoring of site inspections by code enforcement agencies. The Federal government could monitor published sources of construction data to determine the impact of the Standards on the consumption of various construction materials, and also to determine whether such information can indicate actual implementation. Finally, the Federal government could selectively monitor actual construction, which would provide them with information to evaluate the effectiveness of the Standards in 1) reducing life-cycle costs, 2) saving energy, and 3) determining the correspondence between theoretical models of building design energy consumption and actual levels of consumption.

The impacts on Federal, state and local governments and on the building industry are likely to increase dramatically if the Standards are updated frequently by the Federal government. It has taken many states up to 3 years to implement existing building energy codes, which were not perceived to be very different from the status quo and which required few changes in local code enforcement. Thus, updating the Standards, which are perceived to be quite different from the status quo, at less than 5-year intervals would mean that they would be in a continual state of start-up implementation, and the cost of the Standards program would be high. On the other hand, given increases in the price of energy likey to occur in the future, no updating of the Standards would eventually lead to their becoming outdated and probably ineffective. Stricter Standards are likely to be needed in the future if buildings are to be constructed on a minimum life-cycle cost basis.

The optimal time cycle for updating the Standards can only be found by attempting to balance the costs of implementing new Standards against the benefits in energy savings to be derived by doing so. In this regard optimal updating of the Standards requires an effective monitoring procedure as described above so that the administering agency can always estimate current practice in construction and in energy use patterns.

3.1.3 TOOLS TO ENCOURAGE COMPLIANCE

In addition to administrative actions described above, the Federal government would also assist design professionals, code jurisdictions and the building community by providing them with tangible working tools to mitigate any adverse impacts of an implementation program. The final implementation regulations will include the design requirements of the performance Standards and a method for determining whether a building design complies with the Standards, referred to as the Standard Evaluation Technique (SET). DOE has also undertaken work to develop a Code Equivalency Technique (CET) to be used by state officials in determining which codes can produce buildings determined by the SET to be equivalent to the energy levels set by the Standards. Additionally, procedures will be proposed for approval of Alternative Evaluation Techniques to calculate a building's Design Energy Consumption. This is particularly important because such techniques will provide alternative procedures to the SET which are less costly or less time consuming for calculating residential and small commercial building Design Energy Consumption. These techniques would be of value primarily to states in the code certification process.

However, regardless of whether these techniques are available at the time the implementation rule is proposed, Appendix IV of the final Standards rule will include other draft implementation tools such as

Manuals of Recommended Practice, revised versions of HUD's and FmHA's residential MPS, a revised Model Code for Energy Conservation and a revised ASHRAE-90-75 type standard for commercial buildings. Most code jurisdictions in the country today use these standards or other similiar component-based standards in the administration of their codes. For this reason DOE believes that making component standard equivalents available to the public will be one of the most effective ways of facilitating the implementation of the Standards. The following list describes the range of tools the Federal government is developing to assist designers, code officials and others to comply with the Act.

o Standard Evaluation Technique

DOE is funding development of an SET, which includes a computerized model for determining building compliance with the Standards. The SET will be available to state and local code officials, building designers and others.

o Code Equivalency Technique

DOE is funding development of a CET to facilitate evaluation of code equivalency with the Standards. The CET will use the SET to evaluate the Design Energy Consumption of predetermined prototype buildings. If the Design Energy Consumption of these prototype buildings under a candidate state or local code is less than or equal to the Design Energy Budget allowed by the Standards, the code shall be judged equivalent to the Standards.

o Alternative Computer Evaluation Technique

DOE is funding development of another computer evaluation technique that would be able to evaluate public and private energy computer programs to determine their equivalency to the Standards. This means that energy design/computer programs other than the SET will be available to design professionals wishing to calculate the Design Energy Consumption of a building.

o Prequalified Model Codes

DOE will undertake to qualify several model codes and standards as being equivalent to the Standards. The qualified model codes will be equivalent versions of the existing ASHRAE 90-75, HUD, MPS, and FmHA standards. Modification to the ASHRAE standards would include both a component and performance option as energy performance paths.

o Simplified Calculation Technique

A simplified calculation technique could be developed, consisting of workbooks and manual calculation procedures for undertaking the energy consumption calculations required for determining compliance with the Standards. These procedures could be made available to code enforcement

officials and design and construction professionals to assist them in undertaking calculations necessary to determine compliance with the Standards.

o Manual of Recommended Practice

DOE will make available a "Manual of Recommended Practice" that could be used by the design profession to meet the requirements of the Standards. This manual would include a list of approved codes, model building designs, and criteria for individual components of a building system. The manual would also include various combinations of conservation and solar options that would be recommended to meet the Standards. The manual is being designed to familiarize readers with passive and active solar systems. The manual will be designed in a format with which code officials are familiar so as to be used by enforcement officials in the performance of their required tasks and to update existing codes.

3.2 DESCRIPTION OF FOUR ALTERNATIVES FOR IMPLEMENTATION OF FEDERAL ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS

Four implementation alternatives designed to bound the possible range of programs that could be implemented are presented in this section. The alternatives are: Alternative 1, No Sanctions--No Incentives; Alternative 2, No Sanctions--Incentives; Alternative 3, Sanctions--Incentives; Alternative 4, Sanctions--No Incentives. Each alternative is composed of a set of implementation program components which have been described in the preceding sections. An implementation program would be developed by the Federal government in each of the alternatives except Alternative 1.

Each of the alternatives assumes that the Standards are promulgated and the Federal requirements for compliance and monitoring described in Sections 3.1.1.1 and 3.1.2.3, respectively, are in effect. Table 3-1 summarizes the description of the four alternatives that follow.

3.2.1 ALTERNATIVE 1: NO SANCTIONS--NO INCENTIVES

As defined, this alternative would require no additional Federal involvement and virtually no state or local involvement. There would be no incentives or sanctions to encourage compliance with the design energy budgets set by the Standards. No specific implementation tools would be developed. Federal programs that might help BEPS implementation but which were developed primarily for other Federal programs would be considered part of the baseline.

TABLE 3-1: CHARACTERIZATION OF COMPARATIVE IMPLEMENTATION ALTERNATIVE SCENARIOS

Implementation Program	Alternative 1 No Sanctions-No Incentives No Action Alternative	Alternative 2 No Sanctions-Incentives Voluntary Alternative	Alternative 3 Sanctions-Incentives Mandatory Alternative	Alternative 4 Sanctions-No Incentives Most Stringent Alternative
Ways to Comply				
Federal Compliance	Revision of MPS/HUD FmHA, all Federal Buildings must comply	Revision of ASHRAE 90-75R and MPS/HUD FmHA all Federal Buildings must comply	Revision of ASHRAE 90-75R and MPS/HUD FmHA, all Federal Buildings must comply	Revision of ASHRAE 90-75R and MPS/HUD FmHA, all Federal Buildings must comply
Certification Process		Voluntary to receive incentives	Mandatory to receive incentives or to avoid a sanctions	Mandatory to avoid sanctions
Alternate Approval Process			Alternative to certification process	Alternative to certification process
Actions to Encourage Compliance				
Incentives	None provided.	Incentives emphasized	Incentives provided to mitigate sanctions	None provided.
Grants		To state and local jurisdictions	To state and local jurisdictions	
Technical Assistance		To code officials and design professionals	To code officials and design professionals	
Sanctions			Sanctions used for enforcement	Sanctions used for enforcement
Exemptions			Exemption provided	Exemption provided
Program Elements				
Monitoring	Congressional reporting	Congressional reporting	Congressional reporting	Congressional reporting
Updating		Potentially to maintain the effectiveness of Standards	Required periodically	Required periodically
Tools to Encourage Compliance				
SET, CET, Alternative Computer Evaluation Technique, Prequalified Model Codes, Simplified Calculation Technique, and Manuals of Recommended Practice	None provided	Provision of a full set of tools to designers, code officials, and others to achieve compliance	Provision of a full set of tools to designers, code officials, and others to achieve compliance	Provision of a full set of tools to designers, code officials, and others to achieve compliance
Model Code				
Grants				
Simplified Calculation Technique				
Educational Training Materials				
Technical Assistance				
Testing and Certification of Materials				

3.2.1.1 WAYS TO COMPLY WITH THE STANDARDS

This alternative includes only the Federal requirements for compliance described in Section 3.1.1.1. Neither the certification process nor the AAP is assumed to exist under this alternative. However, since the Standards represent a cost-effective energy-conserving potential, it is possible that they would be voluntarily adopted by national standard or model code groups in code revisions. The promulgated Standards, utilized as a standard (goal) for developing codes, would enhance the level of implementation over and above the actions specified under Federal compliance.

3.2.1.2 ACTIONS TO ENCOURAGE COMPLIANCE

The only action to encourage compliance is in the Federal monitoring requirement of the Act described in Section 3.1.2.3. None of the incentives or sanctions discussed in Section 3.1.2 are in effect.

3.2.1.3 TOOLS TO ENCOURAGE COMPLIANCE

Under the assumptions of Alternative 1, no tools to encourage compliance would be provided.

3.2.2 ALTERNATIVE 2: NO SANCTIONS--INCENTIVES

This alternative represents a voluntary program which achieves implementation and compliance through Federal incentives and tools to encourage compliance provided to code enforcement agencies, building industry groups and market participants.

3.2.2.1 WAYS TO COMPLY WITH THE STANDARDS

Compliance under Alternative 2, No Sanctions--Incentives, would be achieved through a certification process or alternatively through an AAP, described in Sections 3.1.1.2 and 3.1.1.3, respectively.

3.2.2.2 ACTIONS TO ENCOURAGE COMPLIANCE

Incentives under Alternative 2 would include public information, grants, technical assistance and demonstration projects as defined in Section 3.1.2.1.

3.2.2.3 TOOLS TO ENCOURAGE COMPLIANCE

The following implementation tools, described in more detail in Section 3.1.3, would be provided under this alternative:

- o A Standard Evaluation Technique (SET), a computerized model for determining building compliance with the Standards.
- o A Code Equivalency Technique (CET) to facilitate the qualification of code equivalency with the Standards.
- o Alternative Computer Evaluation Technique
- o Existing model codes and standards qualified as being equivalent to the Standards.
- o A simplified calculation technique with a workbook and a manual calculation procedure to undertake energy consumption calculations.
- o A "Manual of Recommended Practices" which could include approved codes, model buildings and component systems.

3.2.3. ALTERNATIVE 3: SANCTIONS--INCENTIVES

Alternative 3 is most representative of the proposed action. This alternative would require major Federal action to develop and administer sanctions and incentives. It represents the most substantial commitment envisioned for the alternatives on the Federal, state and local level. The sanction, as presently defined in the Act, has been described in Chapter 2. In order to mitigate many of the impacts of implementing the sanctions, this alternative would provide administrative actions and tools to encourage compliance as discussed under Alternative 2, No Sanctions—Incentives.

3.2.3.1 WAYS TO COMPLY WITH THE STANDARDS

Compliance with the Standards under Alternative 3, Sanctions--Incentives, is mandatory in the sense that buildings must comply with the Standards in order to avoid the imposition of the sanction. Applicants for Federal financial assistance can avoid imposition of the sanction through one of three methods: (1) a certification process, (2) an APP, or (3) exemptions (as described in Section 3.1.4).

To enable the Federal agencies to administer the sanctions, the Federal government would publish and periodically update a list of states and local jurisdictions that have either adopted and enforced codes that are equivalent to the Standards or been granted exemptions from the Standards. The regulated financial institutions would receive these lists in order to know which areas can automatically avoid the sanction. Before approving a construction loan, a lender must determine whether that building complies with the Standards. If the building is constructed in a state or local jurisdiction listed by the Federal government as either having an equivalent code or having been granted an exemption, the lender may approve the loan. If the building is not located in a listed state or local jurisdiction, the lender must require, before approving a loan for a building, a Certificate of Building Compliance from a local or state administering agency declaring that the design has been determined to be in compliance with the Standards pursuant to an AAP.

3.2.3.2 ACTIONS TO ENCOURAGE COMPLIANCE

Alternative 3, Sanctions—Incentives, comprises both incentives and sanctions. The set of incentives considered for this alternative are the same as those described under Alternative 2, No Sanctions--Incentives. The sanctions that would be imposed under this alternative are those administrative sanctions spelled out in the statute and described in Chapter 2 and Section 3.1.2.2.

3.2.3.3 TOOLS TO ENCOURAGE COMPLIANCE

The same implementation tools described under Alternative 2, No Sanctions—Incentives, would be provided to encourage implementation of the Standards.

3.2.4 ALTERNATIVE 4: SANCTIONS—NO INCENTIVES

Alternative 4, Sanctions--No Incentives, assumes that sanctions would be the primary compliance component and that no incentives would be provided. Thus, this alternative represents the most stringent alternative for implementation. The burden of implementing the Standards would be placed on state and local governments and would not be mitigated by incentives, thus making it more difficult and costly for states or localities to comply through the certification process, AAP or exemptions.

3.2.4.1 WAYS TO COMPLY WITH THE STANDARDS

Compliance with the Standards under Alternative 4, Sanctions--No Incentives, is mandatory in the sense that buildings must comply in order to avoid the imposition of the sanction on the construction of new buildings. Certification process, AAP and exemptions would be the means of avoiding the sanction.

3.2.4.2 ACTIONS TO ENCOURAGE COMPLIANCE

A Federal sanction is envisioned as the only compliance component; therefore, the number of requests for exemptions under this alternative is expected to be higher. This administrative sanction has been discussed in detail in Chapter 2 and Section 3.1.4.

3.2.4.3 TOOLS TO ENCOURAGE COMPLIANCE

The same implementation tools described under Alternative 2, No Sanctions—Incentives, would be provided to encourage implementation of the Standards. To deny the tools would be an additional sanction.

3.3 PENETRATION RATES

The rate of adoption (penetration rates) associated with the Standards are a driving force in the impact analysis of the Standards. Rate of

adoption is defined as the fraction of new construction affected by the Standards. This section first discusses the relationship between the sanction described in the Act and the penetration rates of the Standards, and then assigns penetration rates to each of the four alternatives.

It was not possible to describe completely the analytic relationship between the four alternatives and penetration rates because of data deficiencies. However, four pieces of information were derived that allowed some quantification of this relationship. Available data allowed estimation of: 1) federally assisted new mortgages (HUD/MPS and FmHA) as a percent of all new residential construction (15%), 2) the percent of new residential and commercial building that use either construction or mortgage loans from either a federally regulated private financial institution, a Federal mortgage insurance program or a Federal secondary mortgage company (at least 66%), 3) Federal building construction as a percent of all nonresidential construction (6%), and 4) the percent of building in areas with an energy code (85%). Data sources and methodologies used to derive these estimates are discussed in Appendix A.

If the Standards are promulgated without sanctions or incentives, as in Alternative 1, then it is assumed that at minimum, all FHA, VA and FmHA mortgage-insured building would comply with the Standards; also, all Federal building would comply with the Standards. Thus, the minimum residential and commercial penetration rates assuming no sanctions or incentives would be 15% and 6%, respectively.

If the Standards are implemented with the sanction as discussed in Pub. L. 94-385 and if all buildings that use either construction or mortgage loans from either a federally regulated private financial institution, a Federal mortgage insurance program or a Federal secondary mortgage company are assumed to be in compliance with the Standards after 1981, a penetration rate of 66% in 1982 is expected. If the Standards are administered with the sanctions and if all states and localities that currently have energy codes will have modified these codes to meet the Standards by 1983, a penetration rate of 85% is expected.

Given the information discussed above, five penetration paths were developed (Table 3-2). The five paths selected represent a reasonable bound on the expected penetration rates of the Standards for a reasonable implementation program. A penetration rate of 66% was selected as the maximum achievable penetration rate for 1982 because comments from code officials indicated this was a reasonable upper bound. The maximum upper bound of 100% penetration by 1982 was analyzed in the DEIS, and thus was not included here.

The information discussed above was used to formulate the relationship between implementation alternatives and penetration rates. Alternative 1, No Sanctions--No Incentives, would be expected to have minimum residential and commercial penetration rates of 15% and 6% respectively. Alternative 3, Sanctions--Incentives, and Alternative 4, Sanctions--No Incentives, would be expected to have a minimum

TABLE 3-2: PENETRATION RATES

Percentage (%) of the New Residential and Commercial Buildings in Compliance with Standards

	1982		1983		1985		1990		1995		2000	
Scenario	Res.	Comm.	Res.	Comm.	Res.	Comm.	Res.	Comm.	Res.	Comm.	Res.	Comm.
PR-1	66.5[a]	66.5	90.5	90.0	91.6	91.2	94.4	94.1	97.2	97.0	100.0	100.0
PR-2	60.0	43.0	84.0	77.0	85.3	78.8	88.5	83.2	91.7	87.6	95.0	92.0
PR-3	60.0	43.0	70.0	61.0	72.4	63.6	78.3	70.1	85.2	76.5	90.0	83.0
PR-4	50.0	30.0	51.0	32.0	52.0	36.1	57.4	46.2	62.0	56.3	66.5	66.5
PR-5	15.0[a]	6.0[a]	15.0	6.0	15.0	6.0	15.0	6.0	15.0	6.0	15.0	6.0

[a]These estimates are based on 1976 data (see Appendix A). Other numbers presented in this table are based only on what analysts felt was reasonable to bound the expected penetration rates of the Standards.

residential penetration rate of 66% in 1982 and 85% from 1983-2000. High, low and probable penetration paths for the alternatives were formulated using the information derived above and analysts' hypotheses on the relationship between the alternatives and penetration rates. A reasonable range of penetration was assigned to each alternative in order to bound the analysis. Thus, at best the alternatives are bounded in order to show the spectulative nature of the analysis. The penetration paths for the four alternatives, the range and the likely penetration are shown below.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
High	PR-4	PR-2	PR-1	PR-1
Low	PR-5	PR-4	PR-3	PR-4
Probable	PR-5	PR-2	PR-1	between PR-2 and PR-3

The analysis carried out to estimate penetration rates has several limitations. First, data deficiencies exist; thus, data assumptions were made to derive residential penetration rate estimates. Second, 1976 data were used. The validity of these penetration rate estimates depends, in part, on the representativeness of the 1976 data. Third, it is likely that if Federal mortgage and construction loan funds are cut off for a recalcitrant area, some construction that would have used federally regulated funds would find other funding sources. The extent to which that would happen is unknown at this point. However, this effect may lead to a lower penetration rate than the rates discussed above because some buildings may defy the Standards if they are confident of receiving non-federally regulated funds. Third, even though only 15% of new building value is FHA, VA or FmHA insured, a higher percentage of buildings meets FHA, VA, FmHA standards. Builders would build speculation units to the FHA, VA, FmHA standards so that they do not foreclose that type of buyer. This effect would increase the penetration rate; however, the magnitude of the effect is unknown.

3.4 COSTS OF IMPLEMENTING AND ADMINISTERING THE STANDARDS

This section first presents the estimated costs to government associated with specific elements of an implementation program. This information is then used to estimate the implementation costs associated with the four alternatives. Detailed methodology is outlined in Appendix B.

3.4.1 COSTS ASSOCIATED WITH IMPLEMENTING AND ADMINISTERING THE STANDARDS

Implementation costs are defined as the "front end" costs to the Federal and state and local governments of taking the actions necessary to implement the Standards. Administrative costs are defined as the ongoing operational costs to the Federal, state and local governments of administering the Standards program. Additional operating costs may result from either administering equivalent state and local codes for Standards compliance, or administering AAPs.

3.4.1.1 FEDERAL IMPLEMENTATION COSTS

Implementation, or front end, costs of the components of a Federal implementation program were estimated. Components of such a program include (1) ways to comply with the Standards, (2) actions to encourage compliance with the Standards and (3) tools to encourage compliance. Table 3-3 presents estimates of these costs by component and by the elements that make up the components. These estimates have been developed by DOE in cooperation, where appropriate, with other Federal agencies. Some of the cost estimates are of a speculative nature and should only be used as an indication of the magnitude.

The Federal costs of developing ways to comply with the Standards include the costs of (1) developing procedures for ensuring that Federal buildings comply, (2) revising the HUD/MPS and promulgating MPS to be consistent with the Standards, and (3) developing technical and procedural requirements for Standards compliance via equivalent codes or an AAP and taking the necessary actions to implement these requirements. These ways of complying with the Standards represent a range of possible options available to the Federal government. They may not all be used in the final implementation program.

The Federal costs of developing actions to encourage compliance with the Standards include the costs of (1) developing and providing incentives, (2) developing and implementing Federal sanctions, (3) developing systems for monitoring and reporting to record adoption and compliance, and (4) developing systems for updating the Standards after a period of experimentation and trial.

The Federal costs related to implementation tools consist of the costs of developing and providing (1) a Standard Evaluation Technique, (2) a Simplified Calculation Technique, consisting of manual calculation procedures and workbooks, (3) a Code Equivalency Technique, (4) updated and prequalified model codes, and (5) a manual of recommended practices.

TABLE 3-3: FEDERAL GOVERNMENT IMPLEMENTATION AND ADMINISTRATION COSTS
(1978 Dollars)

Ways to Comply with the Standards	Implementation Costs	Administration Costs
Federal Compliance		
Federal Buildings	$ 200,000	$ 50,000
Revision of MPS/HUD, FmHA		
Revise ASHRAE 90-75 or	900,000	100,000
Do Not Revise ASHRAE 90-75	300,000	100,000
Certification Process	N/A	N/A
AAP	N/A	N/A
Subtotal	500,000-1,100,000	1,500,000
Actions to Encourage Compliance with the Standards		
Incentives		
Grants	3,500,000	500,000
Technical Assistance	600,000	100,000
Public Information	3,500,000	500,000
Sanctions	800,000	300,000
Monitoring and Reporting	500,000	100,000
Subtotal	8,900,000	1,500,000
Federal Implementation Tools		
Standards Evaluation Technique	1,600,000	
Simplified Calculation Techniques, consisting of manual calculations and workbooks	1,000,000	
Code Equivalency Technique	1,400,000	
Updated and Prequalified Model Codes	600,000	
Manual of Recommended Practices	800,000	
Subtotal	5,400,000	
Total	$14,800,000-15,400,000	$1,650,000

3.4.1.2 STATE AND LOCAL IMPLEMENTATION COSTS

The costs to state and local governments of implementing the Standards under a certification process have been estimated based on previous costs of implementing existing energy codes. As noted in Section 4.1.2, the actions taken by different state and local governments to implement existing energy codes have varied considerably, and have included: revising and adopting codes; developing and providing education, training and technical assistance to building officials, designers and builders; and hiring additional staff for additional enforcement responsibilities at the local level and new oversight and enforcement responsibilities at the state level. Thus, the data on state and local code implementation costs represent the costs of taking these actions. The costs of implementing the Standards by establishing AAPs have not been estimated at the state or local level because there were no representive costs that existed for a similar process.

The additional staff necessary for enforcing a code could represent an ongoing, administrative cost rather than an additional implementation cost. However, the information available did not allow these costs to be separately identified. These estimates assume that it would take state and local governments 3 years to develop, adopt and fully implement energy codes for Standards compliance, and that all additional costs above those incurred in the absence of Standards during this period are implementation costs. This 3-year period agrees with the time taken by many states to adopt building energy codes in response to DOE's State Energy Conservation Program (SECP).

The methodology used to estimate state implementation costs is described in Appendix B. The estimate of these costs, assuming equal costs for every state regardless of present code status, is calculated to be $31.0 million, irrespective of how the implementation programs are funded. It is projected that a Federal incentives program will be structured and funded to the degree that a maximum level of grants will be authorized to equal the state implementation costs. Any excess funding would be transferred to the localities to finance their implementation program. Federal grants totalling $31.5 million have been programmed for utilization by the states for implementation purposes.

The methodology used to estimate local implementation costs is also described in Appendix B. Estimated implementation costs to local jurisdictions are:

High estimate	$17.3 million
Low estimate	$ 2.8 million.

These are the costs that could be incurred in the first year by local jurisdictions.

3.4.1.3 FEDERAL ADMINISTRATION COSTS

Although many of the administrative costs to the Federal government are not quantifiable, estimates totaling $1,650,000 have been calculated and are shown in Table 3-3.

3.4.1.4 STATE AND LOCAL ADMINISTRATION COSTS

State and local administration costs were estimated for a representative year (1982) by first estimating, for both the residential and commercial sectors, the cost of complying with the Standards via both the certification process and the Alternate Approval Process and then using both prescriptive and performance paths. It is assumed that all building designs go through one of the compliance procedures.

Estimates of local administration costs of the Standards are based on the following assumptions. First, all states and local jurisdictions with building energy codes will choose to adopt energy codes for Standards compliance. Thus, the 78% of all new building that are currently regulated by either a state or local code will comply with the Standards via the certification process.

It is further assumed that 2% of all residential units will use a performance path for complying with the Standards, and that this percentage will apply to all residential buildings regardless of whether they comply via the certification process or an AAP. The average cost of compliance via a performance path is estimated to be $500 per residential building ($200 for computer use and $300 for professional fees). Costs for the remaining 98% of all residential units that will comply via a prescriptive path are estimated as $25 for AAP compliance, and an additional 10 minutes of time (valued at $40 per hour) under the certification process for plan review and building inspection. As indicated in Table 3-4, the total additional administrative costs of Standards compliance for residential buildings are estimated at $37.2 million per year.

It was assumed that 60% of commercial buildings would comply via a prescriptive path, and 40% via a performance path, and that these percentages would apply to all commercial buildings regardless of whether they comply via a certification process or an AAP. The total cost of commercial building compliance is estimated to be $14.6 million for the 40% of buildings that comply via a performance path and $1.4 million for the 60% that comply via a prescriptive path, for a total of $16.0 million. As shown in Table 3-4, the total additional administrative costs of Standards compliance for all building types are estimated at $53.2 million per year. Total additional costs divided equally between

TABLE 3-4: LOCAL ADMINISTRATION IMPLEMENTATION COSTS ESTIMATION 1980

Residential 1980 (Assume 2 x 10^6 units 1982)
(78% of units are built within jurisdiction with codes) (22% without codes)

Performance		Prescriptive	
Certification	AAP	Certification (Assume additional 10 min)	AAP (Assume $25)
$(2.0 \times 10^6)(0.02)(0.78)(500) = 15.6 \times 10^6$	$(2.0 \times 10^6)(0.02)(0.22)(500) = 4.4 \times 10^6$	$(2.0 \times 10^6)(0.98)(26/6)(0.75) = \$6.4 \times 10^6$	$(2.0 \times 10^6)(0.98)(\$25)(0.22) = \$10.8 \times 10^6$

Total Residential = 15.6 + 4.4 + 6.4 + 10.8 = 37.2×10^6

Commercial 1980 (1.377×10^9 ft^2 (Assume average building 30,000 ft^2))

Performance (40%)		Prescriptive (60%)	
(78%) Certification	(22%) AAP	(78%) Certification	(22%) AAP
$(0.40)(24)(25) + 200(45,900)(0.78) = 11.4 \times 10^6$	$(0.40)(24)(25) + 200(45,900)(0.22) = 3.2 \times 10^6$	$(0.60)(2)(25)(45,900)(0.78) = 1.1 \times 10^6$	$(0.60)(2)(25)(45,900)(0.22) = 0.3 \times 10^6$
		1.4×10^6	

Total Commercial = 14.6 + 1.4 = 16.0×10^6

Total Residential and Commercial = 37.2 + 16.0 = 53.2×10^6

state and local jurisdictions are calculated to be $1,000,000 for the purposes of monitoring and record keeping, filing, office materials, etc. Thus, the total annual costs of administering the Standards are estimated to be $53.7 million (53.2 + .5) to local code jurisdictions and $.5 million to states (see Tables 3-4 and 3-5).

Table 3-5 summarizes the estimated costs of implementing the Standards and the costs of administering Standards compliance. These estimates, based on a maximum level of first costs and a maximum estimate of administrative costs, are estimated to be $120,050,000.

TABLE 3-5: TOTAL IMPLEMENTATION COSTS

Federal	
Implementation	$ 15,400,000
Administration	1,650,000
Subtotal	17,050,000
State*	
Implementation	31,500,000
Administration	500,000
Subtotal	32,000,000
Local*	
Implementation	17,300,000
Administration	53,700,000
Subtotal	71,000,000
Total	$120,050,000

*This cost may be reimbursed by the Federal Government.

3.4.2 COSTS OF IMPLEMENTING AND ADMINISTERING THE STANDARDS BY ALTERNATIVE

Implementation and administrative cost estimates for the four implementation alternatives are developed. Total costs for each alternative have been derived by analyzing the components of the alternative and computing the implementation or start-up cost and the administrative or ongoing costs associated with each component of the implementation program.

The first two columns of Table 3-6 show estimated one-time costs and annual costs, respectively, incurred by the Federal government to implement the Standards. These costs are disaggregated by expenditure on components that compose each alternative. The last column contains a range of cumulative costs, from 1980-2020, to all levels of government to administer and enforce the Standards. These costs are in constant 1978 dollars and are based on both penetration rates and average costs of implementing and enforcing Standards of $18 per residential unit and $0.01/sq. ft. for commercial buildings. These estimates were developed from the information in Table 3-4. The annual equivalent of the costs in the last column of Table 3-6 has already been presented in Table 3-4 for a representative year assuming full compliance. The assumption of full compliance yielded maximum administrative costs. The costs developed here are specific to the range of penetration rates assumed for each alternative and change annually in direct proportion to the estimated penetration rate. The yearly totals are then discounted and summed to yield cummulative costs between 1980 and 2000. A range of costs is given to represent the low and high penetration estimates for each alternative.

Alternative 1, No Sanctions--No Incentives, proposes a program consisting of no federally sponsored intervention other than the revision of HUD/MPS, forced compliance of new Federal buildings, and a monitoring and reporting system to track adoption and compliance of state and local energy codes. This represents a minimal cost alternative and would affect only new residential building units subsidized and/or insured by Federal programs (15% of total). It is estimated that to revise HUD/MPS to be equivalent to the Standards, it would cost $200,000 with an additional $100,000 needed annually for administrative expenditures. The revision process would affect other Federal agencies employing MPS and would likely result in a one-time cost of $100,000. An additional $500,000 is attributed to the development of a monitoring and reporting system which would document adoption and compliance at an annual cost of $100,000.

Alternative 1 would also require new Federal buildings to be constructed in compliance with the Standards. Federal agencies would incur one-time costs of $200,000 with additional administrative costs of $50,000 annually. Total administrative costs in the first year plus one-time costs to the Federal government under the No Sanctions--No Incentives Alternative would be $1,250,000 (see Table 3-6). Implementation and enforcement costs increase over time as some jurisdictions voluntarily adopt the Standards. The estimated present value of these costs cumulatively from 1982-2000 ranges from $50-$210 million.

Alternative 2 would include the utilization of a full range of incentives to encourage compliance with the Standards. Grants and technical assistance totaling $35,600,000 would be made to state and local governments. Of the $35,600,000 in Federal grants, $3,500,000 are for the development of implementation tools such as SET or CET. Associated with the updating of HUD/MPS an additional $600,000 would be made available to upgrade the energy section of ASHRAE 90-75R. This

TABLE 3-6 IMPLEMENTATION AND ADMINISTRATIVE COSTS OF ALTERNATIVES (1978 DOLLARS)

	Federal		Total Administrative Costs to State and Local
	Implementation (one-time)	Administrative (annual)	Cumulative (1980-2000)
Alternative 1: No Sanctions-No Incentives			$50,000,000 - 210,000,000
A. Revision of HUD/MPS (other agencies)	200,000	100,000	
B. Revision of HUD/MPS	100,000	----	
C. Monitoring and Reporting	500,000	100,000	
D. Adoption and Compliance by Federal Buildings	200,000	50,000	
TOTAL	$1,000,000	$250,000	
Alternative 2: No Sanctions-Incentives			$210,000,000 - 330,000,000
A. All Costs under Alternative 1	1,000,000	250,000	
B. Revision of ASHRAE 90-75R	600,000	100,000	
C. Grants and Technical Assistance	35,600,000	600,000	
D. Implementation Tools	5,400,000	---	
E. Public Information	3,500,000	500,000	
TOTAL	$46,100,000	$1,450,000	

	Federal		Total Costs to Federal State and Local
	Implementation (one-time)	Administrative (annual)	Cumulative (1980-2000)
Alternative 3: Sanctions-Incentives			$310,000,000 - 380,000,000
A. All Costs under Alternative 2	46,000,000	1,450,000	
B. Sanctions and Promulgation			
1. Development	500,000	100,000	
2. Liaison and Training	300,000	200,000	
TOTAL	$46,900,000	$1,750,000	
Alternative 4: Sanctions-No Incentives			$210,000,000 - 380,000,000
A. All Costs under Alternative 1	1,000,000	250,000	
B. Revision of ASHRAE 90-75R	600,000	100,000	
C. Sanctions and Promulgation	800,000	300,000	
D. Cost of Implementation Tools	5,400,000	---	
TOTAL	$7,800,000	$650,000	

$600,000 plus the $31,500,000 ($35,000,000 - $3,500,000) for a total of 32,100,000 would be used by the state and local governments for the purposes of developing and implementing energy codes, staffing, training, monitoring and reporting systems and equipment if necessary. In addition, the various implementation tools will be made available to assist designers, builders, code officials and others. A total cost level of $5,400,000 has been estimated. A detailed breakdown of the costs of these tools is shown in Table 3-3. One-time costs to the Federal government for Alternative 2 plus administrative costs in the first year would be $47,550,000. Total cumulative costs of administering and enforcing the Standards range from $210-$330 million.

Alternative 3 represents an approach which authorizes both incentives and Federal sanctions. The incentives programs have been combined with Federal sanctions to maximize Federal, state, and local efforts to ensure that the goals of the Standards are met. It is a maximum effort in order to ensure adoption and compliance to the Standards. As a result total expenditure would include all of the costs estimated above for the No Sanctions--Incentives Alternative as well as development and promulgation of the sanctions, and training to facilitate understanding and applicability. Total costs to the Federal government are estimated to be $46,900,000 allocated to implementation and $1,750,000 to administrative costs. Total cumulative costs of administering and enforcing the Standards range from $310-$380 million.

Alternative 4 assumes the implementation of sanctions as the only action to encourage compliance. Sanctions have been discussed in Section 3.1.2.2 as to their content and expected effects. The cost of implementing this alternative is estimated at $8,450,000 to the Federal government. The majority of expense is related to the costs of developing the equivalency tools ($5,400,000). Total costs over time range from $210-$380 million.

3.5 COMPARISON OF IMPACTS BY ALTERNATIVE

This section of the Supplement compares the alternatives and their institutional, socioeconomic and physical environmental impacts. Table 3-7 summarizes the impacts that will be caused by each alternative. The table allows for comparison of alternatives so that the trade-offs between alternatives can be evaluated.

3.5.1 COMPARISON OF INSTITUTIONAL IMPACTS

Institutional impacts of alternatives on Federal, state and local governments and building industry groups are compared. The Federal,

TABLE 3-7: COMPARISON OF IMPACTS BY ALTERNATIVE

Alternative 1 No Sanctions-No Incentives	Alternative 2 No Sanctions-Incentives	Alternative 3 Sanctions-Incentives	Alternative 4 Sanctions-No Incentives
INSTITUTIONAL			
Federal Government			
Federal and federally insured buildings must comply.	Federal and federally insured buildings must comply.	Federal and federally insured buildings must comply.	Federal and federally insured buildings must comply.
Cost of revising HUD/MPS	Cost of revising HUD/MPS	Cost of revising HUD/MPS	Cost of revising HUD/MPS
Cost to agency for administering above existing energy code administration.	Cost to agency for administration above existing energy code administration.	Cost to agency for administration above existing energy code administration.	Cost to agency for administration above existing energy code administration.
	Additional cost for incentives program administration.	Additional cost for incentives program administration.	
		Agency impact of administration of sanction program.	Agency impact of administration of sanction program.
		Promulgation of regulations to authorize sanction administration.	Promulgation of regulations to authorize sanction administration.
	Responsibility for implementation maintained at Federal level with a voluntary-incentives program.	Responsibility for implementation maintained at Federal level with shift of enforcement to local.	Responsibility of ensuring enforcement maintained at Federal level.
	Voluntary program with grants and technical assistance may increase enforcement and decrease institutional resistance.	Mandatory program with incentives may provide greatest enforcement with limited resistance due to multiple compliance paths.	Mandatory program with no mitigation will probably increase resistance.
	Broader range of incentives than under SBCPP—creating more demand for energy efficient housing.		
State and Local Governments			
Considered to have minimal impact at the state and local level.	Considered to have limited impact, because voluntary and compensated by incentives.	Considered to have major impact as state and local will need to respond to incentives and sanction program requirements.	Considered to have most severe impact, transfers responsibility to state and local.
Cost impact possible if state and locals wanted to comply voluntarily.	Cost impact limited, grants provided for implementation and administration to encourage compliance.	The majority of cost impacts could be compensated with grants to state and local jurisdictions.	Cost impact transferred to state and local.

TABLE 3-7: (contd)

Alternative 1 No Sanctions-No Incentives	Alternative 2 No Sanctions-Incentives	Alternative 3 Sanctions-Incentives	Alternative 4 Sanctions-No Incentives
State and Local Governments (contd)			
Major cost incurred for developing implementation tools and voluntary administration.	No cost for developing implementation tools, no cost to administration, code compliance, or AAP.	No cost for developing implementation tools, no cost to administer AAP.	No cost to develop implementation tools, (the cost of developing implementation tools is considered a standards cost not an implementation cost) cost for administrative compliance by either certification or AAP.
No implementing action would provide low compliance unless market forces change demand.	Unless grants and assistance targeted to additional sectors then SECP, incentives may not encourage a high level of compliance.	Targeted incentives and sanctions will provide a high level of compliance except in areas where eligible for exemptions.	Sanctions and no assistance will promote exemptions, AAP compliance or many sanctioned areas.
	Costs only incurred voluntarily.	Sanctions require all state and local jurisdictions to incur costs that are not compensated by incentives--local levels are foreseen as having to pick up deficit.	Sanctions require all state and local jurisdictions to incur costs.
	Local level compliance still voluntary.	Compliance at local level mandatory.	Compliance at local level mandatory.
		Political obstacles with certification.	Political obstacles with certification.
		Exemptions from sanctions that have an impact on level of construction could lead to inequities.	Exemptions from sanctions that have an impact on level of construction could lead to inequities.
		Sanctions increase pressure for compliance.	Sanctions increase pressure for compliance.
		Legal and liability impacts Less impact if we have an AAP.	Legal and liability impact Less impact if we have an AAP.
Building Industry Groups			
Considered to have the least number of negative impacts to building industry groups. Development in use of energy efficient materials on a voluntary basis, thus no impacts.	Considered to have a beneficial impact on building industry groups with the provision of tools and incentives, while being voluntary.	Considered to have the greatest beneficial and negative impacts on building industry groups as sanctions will firm market demand, andincentives will create agreater demand. Higher demand on skills to meet both code compliance and AAP.	Considered to be the severest impact on building industry groups as majority of jurisdictions will be exempt, sanctioned or comply through an AAP. This will shift the burden of compliance to designers.

TABLE 3-7: (contd)

Alternative 1 No Sanctions-No Incentives	Alternative 2 No Sanctions-Incentives	Alternative 3 Sanctions-Incentives	Alternative 4 Sanctions-No Incentives
Building Industry Groups (contd)			
Positive impact of information and training would not occur under this alternative.	Positive impact to groups with incentives provided to market participants to create a demand and tools for compliance.	Positive impact to groups with incentives provided to market participants and tools for design, construction, and manufacturing compliance sanctions increase use of new skills.	Tools provided, but more pressure on groups for compliance-liability increases. New skills required but no training or education program.
Only those dealing with Federal compliance would be involved.	Most designers and contractors would be involved. Manufacturers would be involved because of demand and material certification.	Majority of designers and contractors involved. Manufacturers involved because of demand and material testing and certification.	Majority would need to be involved, not all would have the skills.
		Standards updating would require increased skills and development of new materials and equipment.	Standards updating with no education may result in lack of trained designers and contractors.
SOCIOECONOMIC			
National			
Increase in employment 0.01% - 0.02% (1985) 0.01% - 0.03% (1990)	Increase in employment 0.02% - 0.07% (1985) 0.03% - 0.07% (1990)	Increase in employment 0.05% - 0.09% (1985) 0.06% - 0.10% (1990)	Increase in employment 0.02% - 0.09% (1985) 0.03% - 0.10% (1990)
Increase in GNP 0% (1985) 0% - 0.01% (1990)	Increase in GNP 0% - 0.05% (1985) 0.01% - 0.05% (1990)	Increase in GNP 0.03% - 0.07% (1985) 0.04% - 0.07% (1990)	Increase in GNP 0% - 0.07% (1985) 0.01% - 0.07% (1990)
Short-run change in housing starts[a] Little change	Short-run change in housing starts[a,b] Slight increase	Short-run change in housing starts[a,b] Slight increase	Short-run change in housing starts[a] At most a 2% decrease
Long-run change in housing starts Slight increase	Long-run change in housing starts[b] Slight increase	Long-run change in housing starts[b] Slight increase	Long-run change in housing starts Slight increase

[a]Housing starts impacts were estimated assuming a 2% increase in the first cost of housing complying with the Standards.
[b]Incentives are assumed to include an effective public information program and no tax incentives.

TABLE 3-7: (contd)

Alternative 1 No Sanctions-No Incentives	Alternative 2 No Sanctions-Incentives	Alternative 3 Sanctions-Incentives	Alternative 4 Sanctions-No Incentives
National (contd)			
Short-run change in property values First cost of building complying with the Standards would increase by 2%	Short-run change in property values[b] First cost of building complying with the Standards would increase by 2%	Short-run change in property values[b] First cost of building complying with the Standards would increase by 2%	Short-run change in property values First cost of building complying with the Standards would be discounted below the 2% increase
Long-run change in property values First cost of building complying with the Standards would increase by 2%	Long-run change in property values[b] First cost of building complying with the Standards would increase by 2%	Long-run change in property values[b] First cost of building complying with the Standards would increase by 2%	Long-run change in property values First cost of building complying with the Standards would increase by 2%
Consumers with higher discount rates will perceive less benefits from the Standards A small percentage of low income consumers may be priced out of the new building market	Consumers with higher discount rates will perceive less benefits from the Standards Tax incentives will cause income transfer from society to purchasers of new building that complies with the Standards--No consumers priced out of the new housing market	Consumers with higher discount rates will perceive less benefits from the Standards Tax incentives will cause income transfer from society to purchasers of new building that complies with the Standards--No consumers priced out of the new housing market	Consumers with higher discount rates will perceive less benefits from the Standards A small percentage of low income consumers may be priced out of the new building market
Regional			
Small increase in regional employment and earnings Higher penetration rate will cause slightly greater increase	Small increase in regional employment and earnings Higher penetration rate will cause slightly greater increase Tax credits will cause a slightly greater increase	Small increase in regional employment and earnings Higher penetration rate will cause slightly greater increase Tax credits will cause a slightly greater increase	Small increase in regional employment and earnings Higher penetration rate will cause slightly greater increase
PHYSICAL ENVIRONMENT			
Energy			
Range of energy savings in 1990 and 2000 by alternative:			
1990 0.07 - 0.34 Quads	0.34 - 0.63 Quads	0.57 - 0.74 Quads	0.34 - 0.74 Quads
2000 0.10 - 0.69 Quads	0.69 - 1.1 Quads	1.0 - 1.3 Quads	0.69 - 1.3 Quads
Cumulative energy savings in 1990 and 2000 by alternative:			
1990 0.36 - 1.6 Quads	1.6 - 3.0 Quads	2.7 - 3.6 Quads	1.6 - 3.6 Quads
2000 1.2 - 6.8 Quads	6.8 - 12 Quads	11 - 13 Quads	6.8 - 13 Quads

TABLE 3-7: (contd)

Alternative 1 No Sanctions-No Incentives	Alternative 2 No Sanctions-Incentives	Alternative 3 Sanctions-Incentives	Alternative 4 Sanctions-No Incentives
Natural			
Reduction in emissions of Sulfur Oxide (thousands of tons, T tons) for 1990 by alternative			
20 - 98 T tons	98 - 180 T tons	160 - 210 T tons	98 - 210 T tons
Cumulative reduction in emissions of Sulfur Oxide (thousands of tons, T tons) for 1990 by alternative			
120 - 510 T tons	510 - 920 T tons	820 - 1100 T tons	510 - 1100 T tons
PENETRATION RATES			
Range of penetration estimated in 1982 by alternative			
Commercial Buildings			
6-30%	30-43%	43-43%	30-66.5%
Residential Buildings			
15-50%	50-60%	60-66.5%	50-66.5%
Range of penetration estimated in 2000 by alternative			
Commercial Buildings			
6-66.5%	66.5-92%	83-100%	66.5-100%
Residential Buildings			
15-66.5%	66.5-95%	90-100%	66.5-100%
IMPLEMENTATION COSTS			
Implementation and administrative costs for all governments (Net Present Value in 1978 Millions of Dollars)			
$50-210 MM	$210-330 MM	$310-380 MM	$210-380 MM

and state and local impacts are summarized by alternative in Table 3-8 to allow comparison.

3.5.1.1 IMPACTS ON FEDERAL GOVERNMENT

Each of the alternatives defined in Section 3.2 and summarized in Table 3-1 would have some impact. Alternative 1, No Sanctions--No Incentives, assumes only that the Standards are promulgated. Even this type of implementation program would require that the Federal government revise the MPS for HUD and FmHA and complete some analysis on component-based standards. The principal impacts would be the costs to revise these standards and any additional costs to the agencies who are already administering the construction programs that depend upon these Standards. (See Table 3-6 for an estimate of those costs.)

The impact on the Federal government would generally increase with the other three alternatives. The impacts on cost would be greatest for Alternative 2, No Sanction--Incentives, and 3, Sanctions--Incentives, where incentives comprise a major Federal action to encourage compliance with the program.

Administrative impacts would be greatest for Alternatives 3, Sanctions--Incentives, and 4, Sanctions--No Incentives, where the Federal regulatory agencies would be called upon to administer a sanctions program. Before these agencies could apply sanctions, they would each have to promulgate additional Federal regulations authorizing their member agencies to administer the sanction. It is possible that the agency regulations would not be final before the statutory function took effect. If so, the sanctions might not be uniformly applied.

The impact on Federal building assistance agencies is similar for each alternative. This is because Section 252 of NECPA specifies that MPS/HUD and FmHA must be revised to meet or exceed the Standards, and section 306 of the Act specifies that all Federal agencies responsible for the construction of any Federal building adopt such procedures as may be necessary to assure that any such constuction meets or exceeds the Standards. There are 36 programs under HUD and FmHA which presently utilize MPS, and there are 14 agencies responsible for 31 building assistance programs that are not subject to MPS. The 14 agencies not required to comply with MPS would be more severely affected trying to comply with the Standards through MPS. However, the impact does not vary among the alternatives.

Financial regulatory agencies would be affected only by Alternatives 3 and 4, which provide for sanctions. An alternative with a sanction would require financial regulatory agencies to become involved in implementation under an AAP. Under an AAP, the lending institution becomes the mechanism for enforcing the sanction. The lending institution is responsible for collecting a declaration which is issued by a local official stating that a determination and affidavit are on file to ensure building compliance with the Standards. The analysis indicates

TABLE 3-8: SUMMARY OF FEDERAL IMPACTS BY ALTERNATIVE

	Administering Agency (DOE)	Federal Building Assistance Programs	Federal Financial Regulatory Agencies
Alternative 1	Actions Required: Lead agency either takes action or develops requirements and procedures for the following: Certification Process Public Information Program Monitoring and Reporting Impacts: Time and Costs involved in developing, implementing and administering the Program Components	Actions Required: 1) MPS must be revised to comply with the Standards 2) FmHA must decide whether to adopt FHA's revised MPS or develop their own revisions to comply Impacts: MPS Revision would require additional time and resources	No Action No Impact
Alternative 2	Actions Required: The Lead agency takes action or develops requirements and procedures for the following: Actions to encourage compliance Grants Technical Assistance Market Incentives (Excluding Sanctions) Federal Implementation Tools Standard Evaluation Technique Simplified SET Code Equivalency Technique Prequalified Model Codes Manual of Recommended Administrative Procedures Manual of Recommended Practices Impacts: Time and costs involved in developing, implementing and administering an implementation program	Actions Required: 1) MPS must be revised to comply with the Standards 2) FmHA must decide whether to adopt FHA's revised MPS or develop their own revisions to comply Impacts: MPS Revision would require additional time and resources	No Action

TABLE 3-8: (contd)

	Administering Agency	Federal Building Assistance Programs	Federal Financial Regulatory Agencies
Alternative 3	Actions Required: The Lead agency takes actions or develops requirements and procedures for the following: Program Components (as above) Actions to encourage compliance (as above, however, including Sanctions) Federal Implementation Tools (as above) Impacts: Time and costs involved in developing, implementing and administering implementation program	Actions Required: 1) MPS must be revised to comply with Standards 2) FmHA must decide whether to adopt FHA's revised MPS or develop their own revisions to comply Impacts: MPS Revision would require additional time and resources Actions Required: 1) Programs must develop design criteria meeting the Standards 2) Programs must develop appropriate monitoring and enforcement mechanisms Impacts: Criteria and monitoring mechanism development and administration would require additional time and resources	Actions Required: 1) Integrate new goals with existing agency goals 2) Coordinate activities with lead agency 3) Develop and promulgate regulations 4) Monitor institutions by: a) Adopting or modifying existing monitoring programs such as periodic examinations and call reports b) Developing new procedures to monitor institution compliance where existing methods cannot be adopted (e.g., many existing procedures are concerned primarily with financial solvency and embezzlement protection) 5) Undertake enforcement utilizing: a) Existing procedures, e.g., Involuntary termination of deposit insurance, cease and desist proceedings, temporary cease and desist orders, injunctions, suspension of directors of officers, etc. b) New procedures which may be needed to enforce the sanctions Impacts: 1) Goal Integration o Conflicts may arise with existing agency goals 2) Coordination o Additional time and resources will be needed to coordinate activities with lead agency

TABLE 3-8: (contd)

	Administering Agency /	Federal Building Assistance Programs	Federal Financial Regulatory Agencies
			3) Regulation Development and Promulgation o Additional time and resources to - develop regulations - hold hearings - adopt regulations - disseminate information o Potential legal conflicts with existing regulations 4) Monitoring o Implementation - establish new monitoring procedures - add personnel - train personnel o Administration - potentially more frequent and lengthier monitoring of institutions - may drain resources from other agency objectives 5) Enforcement o More time and resources devoted to enforcement o May drain resources from and delay other enforcement activities o May conflict with other agency objectives
Alternative 4	Actions Required: The Lead Agency takes actions or develops requirements and procedures for the following: Program Components (as above) Actions to encourage compliance (Sanctions only) Impacts: Time and costs involved in developing program components and in designing and enforcing the sanctions component of the implementation program	Actions Required: 1) MPS must be revised to comply with Standards 2) FmHA must decide whether to adopt FEA's revised MPS or develop their own revision to comply Impacts MPS Revision would require additional time and resources Actions Required: 1) Programs must develop design criteria meeting the 2) Programs must develop appropriate monitoring and enforcement mechanisms Impacts: Criteria and monitoring mechanism development and administration would require additional time and resources	As above in Alternative 3

that under Alternative 4 the majority of jurisdictions would use an AAP, whereas under Alternative 3 more than half the states might choose certification. Thus, Alternative 4, Sanctions--No Incentives, would present a greater impact on lending institutions and financial regulatory agencies.

Table 3-8 summarizes impacts of each of the alternatives on the administering agency, building assistance programs and financial regulatory agencies. The administering agency would be most burdened--by determining state and local compliance, developing procedures for approving state and local codes, qualifying model codes, setting equivalency criteria, developing a manual of recommended practice and providing incentives such as grants and technical assistance integrated with information, education and training. This burden is greatest under Alternatives 2 and 3, both of which provide incentives. Alternative 4 also provides implementation tools. The administering agency is responsible for monitoring and updating in all of the alternatives. Additionally, under Alternatives 3 and 4, which include sanctions, the administering agency would be responsible for developing procedures for enforcing the sanctions. This would involve establishing a process for certification, an AAP, and an exemption process. The exemption process would have to include procedures for hearings and appeals. Although Alternative 4 does not include incentives, it would still require code approval, exemptions, monitoring and appeals.

3.5.1.2 IMPACTS ON STATE AND LOCAL GOVERNMENTS

This section compares state and local government[1] impacts for each alternative. Each alternative is evaluated in terms of whether state and local governments would implement a certification process or an AAP. The impacts of an implementation program on state governments would range from only little impact in Alternative 1, No Sanctions--No Incentives, to significant impact in Alternatives 3 and 4 where states may find themselves being required to respond to both sanctions and incentives programs.

Alternative 1, No Sanctions--No Incentives, would have an impact at the state and local level, only to the extent that states choose to comply with the Standards. States with existing energy codes are unlikely to adopt or revise their codes unless the jurisdictions are shown that the benefits accrued would significantly outweigh the cost of voluntary compliance. In the past, most state and local jurisdiction's adopted energy codes only after Federal grants were provided or the incentive of Federal grants was in risk of being witheld. Thus, an alternative

[1] Indian reservations have not been analyzed separately from other units of general purpose local government; however, it is recognized that they may come into compliance or receive exemptions from the Standards in different ways.

risk of being witheld. Thus, an alternative which has no implementation program would only be a little more successful than the projected market forces. With this alternative, there would also be no need for states to establish an AAP. The states would probably depend upon the revision and approval of ASHRAE-90-75R, a process projected to take 2 to 4 years. Voluntary revision of existing state and local energy codes may create significant impacts. Resources would be required to develop or revise a code to be in compliance with the Standards, and resources would have to be available for administering, implementing, enforcing, monitoring and making subsequent revisions to the code.

Alternative 2, No Sanctions—Incentives, is expected to affect states in the same way as the SECP (Pub. L. 94-163), also a voluntary program. Under Alternative 2, grants and technical assistance programs would be made available, but because the alternative would be voluntary, the level of penetration (enforcement) would not greatly exceed the levels presently achieved in response to SECP--at least in the near term, unless incentives were targeted to creating a high level of enforcement. States that have not yet adopted thermal efficiency standards are either unable or unwilling to pass energy codes, and it is doubtful that the grants or technical assistance programs alone would greatly increase the level of enforcement or decrease institutional resistance to building or energy codes. However, the alternative might be more effective over the longer term. The incentives envisioned for the implementation program differ from what was available under SECP in that funds could be available to state and local governments for more than just a plan and code adoption. Additionally, if a tax credit were added to the proposed incentives, market forces would create a further demand for energy efficiency. Public pressure for state and local jurisdictions to be in compliance would increase because consumers probably would want to qualify for tax credits. Local governments would be able to comply because many of the major component standards used by code enforcement officials would be revised and be prequalified under the implementation tools provided.

Thus, as a voluntary program, Alternative 2 has fewer significant impacts for state and local jurisdictions than Alternative 1, principally because of the incentives being provided for the development of codes, grants and assistance programs. These incentives would determine whether jurisdictions with or without codes would be able to comply effectively. The impacts on jurisdictions without building standards and/or codes are expected to be greater for two reasons:

1) New agencies may have to be created for implementation and/or enforcement.

2) Trained manpower would be required.

Alternatives 3, Sanctions--Incentives, and 4, Sanctions--No Incentives, would have the greatest impact on states because sanctions would be implemented. A jurisdiction could avoid a sanction either by adopting a prequalified energy code, by developing an AAP, or by obtaining an

exemption. However, where the state assumes the authority and responsibility for enforcing energy codes or monitoring the costs, its administrative duties increase. Initially, most states are expected to rely on an AAP to comply with the Standards. As time goes on, more and more states would comply via certification with revised or newly developed energy codes.

Failure to comply under Alternative 3 would cause greater impacts than would occur under Alternative 2 because of the primary effects of the sanctions. The impacts of compliance would be greater for those jurisdictions with no experience in adopting, administering or enforcing building or energy codes.

Under Alternatives 3 and 4 , local governments would be under more pressure to ensure that buildings comply. Generally, this means increased costs for code enforcement administration. In some communities few additional costs would be incurred because the code departments would already have the capacity to review energy designs. In fact, over 80% of the construction in the country is already in areas where some form of an energy code has been adopted. (This however, does not ensure enforcement, which is presently voluntary at the local level in most states.)

The exemption described in Alternative 3 can be granted to local jurisdictions by their state, but it must be justified. To apply the exemption uniformly, states would have to become sensitive to construction trends within their boundaries so that they would not penalize a jurisdiction that has taken the initiative to adopt an energy code. This would mitigate the problem of construction shifting from one area where the Standards are being implemented to another where the state has granted an exemption to a code jurisdiction. The state would have to prove that the magnitude of constuction in a certain area did not warrant even the cost of implementing an AAP.

Alternative 4, Sanctions--No Incentives, would have the same adoption, administration, enforcement and monitoring requirements as Alternative 3. However, the impact is considered to be more significant because compliance is mandatory, and there is no program of incentives to provide grants or technical assistance to deviate the impacts. It is expected that most jurisdictions would comply through AAPs. However, an implementation program of this nature could cause many states to refuse to take even limited action or cause them to initiate legal challenges that could delay compliance significantly. Many states would probably opt to qualify for an exemption. With no program for incentives to mitigate state and local impacts, the criteria used to determine exemptions might change, enabling more jurisdictions to comply. This would be due to having a greater cost burden on local governments.

It is unclear at this time exactly to what extent state and local implementation burdens would increase. A study by the National League of Cities indicated that 80% of the cities responding to the questionnaire stated that standards in the form of a component-based code, such as ASHRAE-90-75R, would not require more than an additional 10 to 20 minutes for design review. However, the costs of developing

code departments where none previously existed or of hiring new inspectors would certainly increase enforcement and administration costs. Historically, building code enforcement has been within the authority of the local, not state, government. Even though many states adopted ASHRAE 90-75 pursuant to the SECP, in all but a very few states, enforement was only voluntary at the local level.

Since local jurisdictions would assume responsibility for code enforcement, any institutional impacts would be incurred on that level. For Alternatives 1 and 2 the impacts should be minimal at the local level. Having a modified MPS for HUD or FmHA to comply with the Standards would not change the role of local officials.

There may be some impacts on local jurisdictions which choose to administer the AAP. Even though the regulations would permit a qualified design professional to make the energy determination, an agency of government must be involved in officially noting that an energy determination has been made. Some communities may be unwilling or unable to do even this. Under the Act, responsibility on the local level would lie first with the permit issuing office, unless it is unwilling and unable to assume the responsibility. It would lie second with any local agency office with construction responsibility (fire marshall, etc.) unless that office is unwilling or unable, and third with a state office authorized for this purpose. Where no agency in a jurisdiction is able or willing to administer the process, sanctions would be imposed. This could potentially result in a local construction moratorium.

Potential legal impacts would exist where state laws might automatically transfer liability to local officials, even when a design review is not required by law. DOE is presently researching this and other liability issues in order to address them in the implementation regulations.

Tables 3-9 and 3-10 summarize the institutional impacts of the four alternatives at the state and local level by states with energy codes and states without energy codes, respectively. The estimates of likely state and local compliance paths and impacts summarized in these tables are judgmental in nature and necessarily imprecise. However, they do provide an ordinal ranking of the likelihood of actions, the magnitude of impacts, and so on. The tables are intended to summarize the detailed discussion of impacts provided elsewhere in this chapter, and more precise meaning can be attached to these estimates by referring to these discussions. Column 2 shows three possible compliance paths available to state and local governments: 1) certification process, 2) establishment of an AAP, or 3) no action. Column 3 indicates the severity of the institutional impacts on state and local governments of either of the first two compliance paths. A range of impacts indicates that conditions change from one jurisdiction to another. Thus, the impacts of the certification process may be small in states that cur-

TABLE 3-9: SUMMARY OF STATE AND LOCAL IMPACTS BY ALTERNATIVE FOR A STATE WITH AN ENERGY CODE

1	2	3a	4b				5c				6d			
			Effectiveness in Mitigating Compliance Impacts				Number of Jurisidictions Likely to Take Action				Severity/ Importance of Other Institutional Impacts of Alternatives			
Code Status	Compliance Action	Impacts of Compliance Actions	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Jurisdiction with energy codes	Code Amendment	Low to Moderate	Low	High	High	Low	Few	Many	Many	Few	Low	Low	Low to Moderate	Moderate
	AAP	Low	---	High	High		---	Many	Many	Most	--	Lows	Low to Moderate	Moderate
	No Action	---	---	---	---	---	Most	None	None	None to Few	None	NA	NA	Moderate to Severe

[a]Low - few legal actions required, minor organizational changes, and minor political consequences
Moderate - a number of legal actions required, important organizational changes, and some political opposition
Severe - significant legal actions required, major organizational changes, and significant political opposition

[b]Low - not effective in mitigating impacts of compliance
Moderate - partially effective in mitigating impacts
High - effective in mitigating impacts

[c]Few - less than 5 to 10%
Many - from 10 to 50%
Most - over 50%

[d]None - no other institutional impacts
Low - few legal ambiguities, only minor resistance from state and local agencies, and minor institutional barriers
Moderate - a number of important legal ambiguities, some organizational opposition, and some institutional barriers
Severe - numerous legal ambiguities, significant organizational resistance, and significant institutional barriers

TABLE 3-10: SUMMARY OF STATE AND LOCAL IMPACTS BY ALTERNATIVE FOR A STATE WITHOUT AN ENERGY CODE

1	2	3a	4b				5c				6d			
			Effectiveness in Mitigating Compliance Impacts				Number of Jurisidictions Likely to Take Action				Severity/ Importance of Other Institutional Impacts of Alternatives			
Code Status	Compliance Action	Impacts of Compliance Actions	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Jurisdictions without energy codes	Code Adoption	Moderate to Severe	Low	Moderate to High	Moderate to High	Low	None	Few	Few	None	None	Low	Low to Moderate	NA
	AAP	Low to Moderate	---	High	High	Low	---	Most	Most	Some to Many	---	Low	Low to Moderate	Moderate to Severe
	No Action	---	---	---	---	---	All	Few to None	None	Some to Many	None	None	NA	Severe

[a]Low - few legal actions required, minor organizational changes, and minor political consequences
Moderate - a number of legal actions required, important organizational changes, and some political opposition
Severe - significant legal actions required, major organizational changes, and significant political opposition
[b]Low - not effective in mitigating impacts of compliance
Moderate - partially effective in mitigating impacts
High - effective in mitigating impacts
[c]Few - less than 5 to 10%
Many - from 10 to 50%
Most - over 50%
[d]None - no other institutional impacts
Low - few legal ambiguities, only minor resistance from state and local agencies, and minor institutional barriers
Moderate - a number of important legal ambiguities, some organizational opposition, and some institutional barriers
Severe - numerous legal ambiguities, significant organizational resistance, and significant institutional barriers

rently play a role in monitoring or enforcing a state code and moderate in those states that play little or no role.

Column 4 indicates the effectiveness of each of the alternatives in mitigating the impacts of state and local compliance by a certification process or by establishing an AAP. Generally, Alternatives 2 and 3 are highly effective for all jurisdictions, while Alternatives 1 and 4 are not very effective. Again, the variation in effectiveness reflects the fact that the conditions and likely impacts in jurisdictions are not uniform.

Column 5 indicates the number of jurisdictions that are likely to take various compliance paths in response to each of the alternatives. Both Alternatives 2 and 3 are likely to induce compliance by most state and local governments, either by a certification process or AAP establishment. On the other hand, Alternatives 1 and 4 are likely to result in far less compliance by state and local governments.

Column 6 shows the other institutional impacts at the state and local level likely to result from either the alternatives themselves or from the state and local compliance paths being taken in response to these alternatives. This column shows that the existence of the sanctions, or state and local government actions taken in response to sanctions, may result in negative impacts. Under Alternative 4, these impacts could be severe and could jeopardize compliance with the implementation program.

The level of impacts is primarily dependent on the type of implementation program rather than the level of penetration. In summary, Alternative 1 is likely to lead to only a low level of compliance by state and local governments, but it is also likely to result in a very low level of institutional impacts at the state and local level. While Alternative 4 may induce more state or local governments to comply with the Standards, the negative institutional impacts of this alternative may affect compliance. Alternatives 2 and 3 are likely to induce the highest levels of state and local compliance.While the sanctions of Alternative 3 may ultimately result in the highest penetration, that alternative may have higher institutional impacts at the state and local level since it includes mandatory compliance.

3.5.1.3 IMPACTS ON BUILDING INDUSTRY GROUPS

The impact on building industry groups varies for each alternative. Theoretically, the least number of impacts occur with Alternative 1. However, the impacts may not actually be reduced; they may simply be of a different nature. Individual building industry groups involved in the construction of Federal buildings that must comply or buildings designed to meet the revised energy requirements of the MPS would be

affected even by Alternative 1. This fraction of the group would need to be retrained and informed on how building compliance could take place. New specifications for materials and subsystems might result, possibly requiring manufacturers to certify the capabilities of materials or to develop new products or redesign existing ones.

Alternative 2, No Sanctions--Incentives, would require that a larger fraction of the building industry groups be involved in complying with the Standards. The type of incentives provided and how they are applied would determine the impacts on the building industry groups. The implementation tools described under Alternative 2, including manuals of recommended practice and a SET, would be targeted to design and construction professionals. Manuals of recommended practice would provide building plans and component system designs that have been approved as being in compliance with the Standards. Designers and builders would use the SET to evaluate the energy consumption of building via one of the computer programs (e.g. DOE-2) designed for this purpose.

Under Alternative 2, compliance would be voluntary for most buildings. For buildings built for HUD and FmHA and MPS specifications, compliance would be required. Thus, some designers and builders would need to be trained. It may also mean that in one metropolitan area a design and/or builder might have several types of codes which they would be required to meet.

Under Alternative 3, Sanctions--Incentives, the impacts of liability and some redesign discussed in Chapter 5 would apply. However, many of the problems would be resolved because all codes would be equivalent to the Standards, creating consistency among jurisdictions in which the designers and builders work. Additionally, the AAP would benefit designers by allowing them a major role in complying with the Standards. This, of course, would result in a positive economic impact to both designers and builders, because the additional time spent complying with an energy code could be retrieved through fees or the price of building construction. The major negative impacts identified with Alternative 3 involve the initial period of code adoption and liability. During the code adoption period, building designs could be on the drawing boards and might have to be redesigned to meet the new code. This is a very costly process for the designer, and would result in construction delays that would adversely affect builders. The issue of liability, dicussed in Chapter 5, would be a concern under Alternative 3. DOE's research on this issue may define more clearly the impact on designers and builders.

The impacts on building industry groups under Alternative 4, Sanctions--No Incentives, include the concerns discussed in Alternative 3. The same beneficial impact would occur with the provision of implementation tools. Building requirements would be similar and consistent between localized jurisdictions, because all the energy codes adopted would comply with the Standards. Negative impacts would occur because the alternative makes no provision for incentives. Without the incentives of grants and technical assistance, there would be no mechanisms to help train designers and builders.

3.5.2 COMPARISON OF SOCIOECONOMIC IMPACTS

This section compares the impacts of the implementation alternatives on the National economy, industry, employment, consumers and regional economies. As explained in Section 3.3 there is insufficient information to estimate with any degree of confidence what the penetration rate of the Standards would be for a given implementation scenario. Thus, for each alternative we have estimated what the impacts would be for a low and a high penetration rate in an attempt to bound the potential impacts. The impacts for each alternative are summarized in this section and discussed in Chapter 5 and in more detail in Appendix C.

3.5.2.1 NATIONAL ECONOMIC IMPACTS

Table 3-11 shows, for 1985 and 1990, the expected range of changes to key macroeconomic variables under the four different alternatives defined in Section 3.2.* It should be noted that even under Alternative 3 (Sanctions--Incentives), which should exhibit the fastest penetration rate of the Standards, the largest percentage change in any of the indicators is small (i.e., less than 0.1%). The two exceptions are in value of building construction and balance of trade. Building construction is of course directly affected by the Standards. Balance of trade has a baseline value that is close to zero, thus it does not require significantly large changes to affect the percentage change.

3.5.2.1.1 INDUSTRY

The sectors of the economy whose production is most affected by the Standards are displayed in Table 3-12. The projected changes are summarized in Chapter 5.

3.5.2.1.2 EMPLOYMENT

The Standards will have a positive impact on employment in general (see Chapter 5). Employment in some industries, notably the electric utility

*This analysis was done using a notion Input/Output Model (EXPLOR). The coefficients for this model had previously been estimated using 1970 dollars. It was inappropriate to change the year of the dollars because of the large cost and increased error involved and we are primarily interested in estimating changes in physical quantities, not absolute dollar values.

TABLE 3-11: SUMMARY OF MACROECONOMIC IMPACTS (Dollar Figures are in Millions)

Economic Indicator	Alternative	Absolute and Percentage (%) Changes 1985 High		1985 Low		1990 High		1990 Low	
Employment (1,000 jobs)	1	27	(0.02)	16	(0.01)	38	(0.03)	16	(0.01)
	2	85	(0.07)	27	(0.02)	88	(0.07)	38	(0.03)
	3	109	(0.09)	63	(0.05)	119	(0.10)	71	(0.06)
	4	109	(0.09)	27	(0.02)	119	(0.10)	38	(0.03)
Employment Income (Nominal dollars)	1	707	(0.02)	436	(0.01)	1396	(0.03)	583	(0.01)
	2	2316	(0.08)	707	(0.02)	3367	(0.08)	1396	(0.03)
	3	2996	(0.10)	1696	(0.06)	4576	(0.11)	2683	(0.06)
	4	2996	(0.10)	707	(0.02)	4576	(0.11)	1396	(0.03)
Net Final Demand (GNP, $1970)	1	39		0		274	(0.01)	18	
	2	801	(0.05)	39		1041	(0.05)	274	(0.01)
	3	1134	(0.07)	501	(0.03)	1504	(0.07)	767	(0.04)
	4	1134	(0.07)	39		1504	(0.07)	274	(0.01)
Household Expenditure ($1970)	1	20		0		50		0	
	2	170	(0.02)	20		138	(0.01)	50	
	3	216	(0.02)	120	(0.01)	192	(0.02)	107	(0.01)
	4	216	(0.02)	20		192	(0.02)	50	
Domestic Production ($1970)	1	500	(0.01)	500	(0.01)	654	(0.02)	0	
	2	1969	(0.06)	500	(0.01)	1885	(0.05)	654	(0.02)
	3	2622	(0.08)	1345	(0.04)	2725	(0.07)	1394	(0.04)
	4	2622	(0.08)	500	(0.01)	2725	(0.07)	654	(0.02)
Building Construction ($1970)	1	518	(0.50)	132	(0.13)	642	(0.60)	91	(0.08)
	2	1265	(1.22)	518	(0.50)	1334	(1.24)	642	(0.60)
	3	1542	(1.49)	1031	(1.00)	1708	(1.58)	1133	(1.05)
	4	1542	(1.49)	518	(0.50)	1708	(1.58)	642	(0.60)
Trade Balance (Nominal dollars)	1	374	(2.10)	76	(0.4)	1150	(47.70)	80	(3.30)
	2	497	(2.80)	374	(2.10)	1860	(77.10)	1150	(47.70)
	3	547	(3.00)	487	(2.7)	2168	(89.80)	1620	(67.10)
	4	547	(3.00)	374	(2.10)	2168	(89.80)	1150	(47.70)

TABLE 3-12: CHANGES IN DOMESTIC PRODUCTION

Sector	Alternative	Millions of 1970 Dollars 1985 High	1985 Low	1990 High	1990 Low
Electric Utilities	1	-144	-34	-292	-64
(SIC 491, Part 493)	2	-243	-144	-530	-292
	3	-286	-239	-614	-502
	4	-286	-144	-614	-292
Natural Gas	1	0	0	0	0
(SIC 492, Part 493)	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0
Building Construction	1	518	132	642	91
(SIC--Parts of 15,	2	1265	518	1335	642
16 and 17)	3	1542	1031	1708	1133
	4	1542	518	1708	642
Electric Appliances	1	-216	-66	-230	-21
(SIC 361, 362)	2	-281	-216	-284	-230
	3	-283	-285	-290	-283
	4	-283	-216	-290	-230
Distributive Trade	1	48	18	62	15
(SIC 50, 52-59)	2	169	48	153	62
	3	218	128	215	130
	4	218	48	215	62
Services	1	172	87	308	100
(SIC 60-61)	2	437	172	603	308
	3	539	343	757	507
	4	539	172	757	308
Rubber & Plastic	1	222	226	210	210
(SIC 30)	2	238	222	223	210
	3	247	231	233	217
	4	247	222	233	210
Cement	1	171	141	172	128
(SIC 324-329)	2	240	171	236	172
	3	266	217	271	216
	4	266	171	271	172
Log & Sawmill	1	89	82	93	82
(SIC 241, 242)	2	118	89	120	93
	3	130	108	136	111
	4	130	89	136	93

TABLE 3-13: CHANGES IN EMPLOYMENT

Sector	Alternative	Change (1,000 Jobs) 1985 High	1985 Low	1990 High	1990 Low
Electric Utilities	1	-2	-1	-3	-1
(SIC 491, Part 493)	2	-3	-2	-6	-3
	3	-4	-3	-7	-6
	4	-4	-2	-4	-3
Natural Gas	1	0	0	0	0
(SIC 492, Part 493)	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0
Building Construction	1	20	5	24	3
(SIC--Parts of 15 16, and 17)	2	48	20	50	24
	3	58	39	64	43
	4	58	20	64	24
Electric Appliances	1	-5	-2	-5	-1
(SIC 361, 362)	2	-7	-5	-6	-5
	3	-7	-7	-6	-6
	4	-7	-5	-6	-5
Distributive Trade	1	3	1	3	1
(SIC 50, 52-59)	2	10	3	9	3
	3	13	8	12	7
	4	13	3	12	3
Services	1	9	5	15	5
(SIC 60-61)	2	23	9	30	15
	3	28	18	37	25
	4	28	9	37	15
Rubber and Plastic	1	4	4	4	4
(SIC 30)	2	5	4	4	4
	3	5	5	4	4
	4	5	4	4	4
Cement	1	5	4	4	3
(SIC 324-329)	2	6	5	6	4
	3	7	6	7	5
	4	7	5	7	4
Log and Sawmill	1	2	2	2	2
(SIC 241, 242)	2	3	2	3	2
	3	3	3	3	2
	4	3	2	3	2

sector, will fall relative to the baseline. This does not mean that there will be a loss of jobs in those sectors. Rather, it shows a rate of growth of those sectors that is slower than in the baseline environment. Table 3-13 shows impacts on employment by alternatives for 1985 and 1990 for selected sectors of the economy.

3.5.2.1.3 INVESTMENT

Electric and gas utilities are the two sectors whose investment requirements are most affected by the Standards (Table 3-14). Both sectors have lead times of 5 to 10 years on investment decisions, so we show a decrease in investment measured from the baseline projections already occurring in 1980, even though reductions in the demand for energy are negligible in 1980.

The electric appliance industry also requires less investment as the growth in output for that sector decreases. Building construction purchased by commercial and residential sectors increases because of the requirements of the Standards and the increased economic activity fostered by the Standards. Table 3-14 gives a comparison of changes in investment requirements under the four implementation alternative discussed earlier for 1985 and 1990.

TABLE 3-14: CHANGES IN INVESTMENT REQUIREMENTS

		Change (Millions of $ 1970)			
		1985		1990	
Sector	Alternative	High	Low	High	Low
Electric Utilities	1	-629	-169	-683	-30
	2	-863	-629	-878	-683
	3	-886	-860	-917	-855
	4	-886	-629	-917	-683
Natural Gas	1	-88	-88	-77	-82
	2	-88	-88	-76	-77
	3	-88	-88	-75	-76
	3	-88	-88	-75	-77
Electric Appliances	1	-11	-3	-10	0
	2	-14	-11	-12	-10
	3	-14	-14	-12	-12
	4	-14	-11	-12	-10
Building Construction	1	621	175	745	119
	2	1387	621	1450	745
	3	1662	1158	1820	1252
	4	1662	621	1820	745

3.5.2.1.4 CONSUMER

Impacts on the consumer of implementing the Standards include (1) the change in the first cost of construction, (2) the net present value of the investment in the Standards, (3) the effect of consumers' response to the Standards on property values and housing starts, and (4) the equity implications of the Standards. All of these impacts are summarized in Chapter 5 and discussed in detail in Appendix C.

FIRST COSTS OF CONSTRUCTION

The Standards are expected to increase the first costs of residential and commercial dwellings by approximately 2%, on the average. This estimate is discussed in detail in TSD No. 8, Economic Analysis (DOE 1979c). This impact will not vary by implementation alternative.

NET PRESENT VALUE

The net present value (NPV) of investments in energy-conserving improvements required by the Standards is greater than zero for both the residential and commercial uses examined, except for low-rise apartments, assuming a 3% real discount rate, increasing energy prices, and no tax credits. This is discussed in detail in TSD No. 8, Economic Analysis. Provision of tax credits will increase the NPV to the consumer in every case.

CONSUMER RESPONSE

This section briefly summarizes how consumer response to the Standards, as reflected in the residential housing market, may differ among the four alternatives. Two residential housing market variables were analyzed: property values and housing starts. A complete description of consumer response to the Standards is presented in Appendix C.

The impacts reported in this section are based on an econometric analysis that used the best and most recently available data (1973-1976 data by Standard Metropolitan Statistical Areas--SMSA). It is important to note that consumer behavior may have changed since that time as higher fuel prices cause consumers to focus on the tradeoff between using energy-efficient capital or more energy.

Results from the analysis indicate that SMSAs can be grouped into two broad categories: (1) SMSAs where consumers demonstrated a willingness to pay on average $550 for a 30% improvement in housing energy efficiency, and (2) SMSAs where consumers on average did not demonstrate a willingness to pay for housing energy efficiency.

o Alternative 1, No Sanctions--No Incentives

The expected penetration rate for Alternative 1, No Sanctions--No Incentives, is smaller than for the other three alternatives. Therefore, the impacts of the Standards on housing starts and property

values are smaller for Alternative 1 than for the other three alternatives.

A worst case scenario would have the following short run impacts. In localities where an equivalent building code is adopted and where consumers are willing to pay for energy efficiency, housing starts could decrease by as much as 0.9% to 1.4%. New houses may be priced at a discount below the 2% first cost increase in order to sell. The price of older homes that do not comply with the Standards would increase due to increased demand. In localities that have adopted an equivalent energy code and where consumers are not willing to pay for energy efficiency, housing starts could decrease by as much as 1.8 to 2.8% in the short run. The price of new houses would be discounted below the 2% first cost increase.

However, because the short-run penetration rate associated with this alternative is expected to be relatively low, relatively few areas will have adopted an equivalent code. Many consumers will probably be able to choose from among three types of housing in their local area: 1) older houses which may or may not be energy efficient, 2) new houses that comply with the Standards, and 3) new houses that do not comply. If a relatively low percentage of new houses are in compliance, then the impact of the Standards on housing starts is expected to be close to zero. In addition, only slight discounting below the 2% first cost increase of houses that comply with the Standards would be expected. These short-run projections apply to both localities (i.e, willing to pay and not willing to pay for energy-efficiency).

These short-run impacts reflect, in part, imperfect consumer information on the value of the improved housing energy efficiency induced by the Standards. In the long run under Alternative 1, as under all the alternatives, information on the actual value of the Standards would circulate among consumers, and consumers would be expected to become more informed about the benefits of the Standards. Under this long run scenario the price of housing that complies with the Standards would increase by approximately 2%. Housing starts would increase slightly as a result of the Standards.

o Alternative 2, No Sanctions--Incentives

The key difference between Alternative 2, No Sanctions--Incentives, and Alternative 1, No Sanctions--No Incentives, is the presence of incentives. Two potential incentives, tax credits and a public information program to provide information on the value of housing energy efficiency, are examined. Tax credits are not discussed in the Act and, therefore, legislative action would be required before a tax credit program could be implemented. Nevertheless, a tax credit program has been analyzed because it is a possibility.

For the purposes of this discussion, a tax credit is defined as a payment, equal to the increase in housing captial cost due to the Standards, through the tax system to consumers of new housing in compliance with the Standards.

First, consider an implementation program that includes tax credits and no public information program. In localities that have an equivalent energy code and consumers willing to pay for energy-efficiency, the first cost of housing that complies with the Standards would be expected to increase by more than 2% in the short run. This would result from increased demand for housing that complies with the Standards. Housing starts in these localities would be expected to increase between 0.9% to 1.4% in the short run. In localities that have an equivalent energy code and consumers not willing to pay for energy efficiency, the first cost of housing complying with the Standards would be expected to increase by 2%. Housing starts would not change in the short run.

If tax credits are used to encourage implementation of the Standards, a relatively high penetration rate is expected. This would encourage many local jurisdictions to adopt an equivalent code. In the short run, areas that have not adopted an equivalent code and, therefore have less than 100% compliance, should see a greater increase in the value of those houses that do comply and a greater decrease in the value of those houses that do not comply. Impacts on housing starts would be approximately the same; thus, it would be expected that the area would move quickly toward full compliance. In the long run housing starts could increase by as much as 1.8% to 2.8% and housing prices would be expected to increase by approximately 2%.

Second, consider an implementation program that includes an effective public information program and no tax credits. An effective public information program is defined as one that educates consumers on the impact of the Standards on a building's life-cycle cost.

For localities that have adopted an equivalent code, the first cost of housing that complies with the Standards would increase by approximately 2% and housing starts would be expected to increase slightly in both the short run and long run. In areas with less than full compliance the price of housing that complies with the Standards might be bid up by more than 2% in the short run. Also, short-run housing starts might be slightly greater than described above. The locality would be expected to move toward full compliance.

Third, consider an implementation program that includes both a tax credit and public information programs. For localities with an equivalent code, property values of housing that complies with the Standards are expected to increase by more than 2% in the short run and by approximately 2% in the long run. Housing starts in both the short and long run would increase by as much as 1.8% to 2.8%. In the short run, in areas with less than full compliance, the price of housing in compliance with the Standards might be bid higher and housing starts might increase by more than 1.8% to 2.8%. As a result, full compliance would be expected on the long run.

o Alternative 3, Sanctions--Incentives

The penetration rate of Alternative 3, Sanctions--Incentives, is expected to be higher than the penetration rate of the other alternatives. The expected impacts of Alternative 3 on housing first cost and housing starts are similar to the impacts described for Alternative 2 with the exception of the small differences caused by the slightly higher penetration rate.

o Alternative 4, Sanctions--No Incentives

The key difference between Alternative 4 and Alternative 1 is the presence of sanctions in Alternative 4, which will lead to a higher penetration rate. Impacts for individual areas under this alternative should be similar to those discussed under Alternative 1, No Sanctions--No Incentives. The difference is that the cumulative effect under Alternative 4 will be greater because of the higher rate of compliance.

The total short-run impact under Alternative 4 is expected to be no worse than a 1% decrease in housing starts in localities with consumers willing to pay for improved energy-efficiency and no worse than a 2% decrease in housing starts in localities with consumers unwilling to pay.

New housing that complies with the Standards would be discounted below the 2% price increase in the short run. In the long run, a slight increase in housing starts and a 2% increase in housing prices would be expected.

Table 3-15 summarizes the short-run impacts of the various implementation alternatives on housing starts and property values. In the long run, the first cost of housing that complies with the Standards will rise by approximately 2%. Without incentives, housing starts will increase slightly. With tax credits housing starts will increase by from 1.8% to 2.8%. These impacts are presented with limitations. First, inferences were made about nationwide impacts from data on only 11 metropolitan areas. While these cities were chosen with geographical, climatic, economic, and social variation in mind, the representiveness of the sample was not tested statistically. Second, conclusions were reached on impacts expected in the 1980s based on 1973-1976 data. As a result, the impacts presented could change with more recent information and as information for more cities becomes available. In general, one would expect that the bias in these results overemphasizes negative short-term impacts. Arguably, increases in the price of energy have also increased the economic incentives for consumers to evaluate housing costs on a life-cycle basis. Possible increases in the energy-efficiency of houses in recent years would also tend to reduce negative impacts presented here for the short run.

EQUITY IMPLICATIONS

Equity impacts of the Standards would largely be determined by three factors: 1) variation in rates of discount for future expenditures

TABLE 3-15: SUMMARY OF SHORT-RUN IMPACTS OF THE STANDARDS ON HOUSING STARTS AND PROPERTY VALUES BY IMPLEMENTATION ALTERNATIVE

Implementation Alternative	Residential Penetration Rate Range for 1982 and 2000	Expected Impacts of the Standards on Housing Starts [a]: SMASs "Willing to Pay" for Energy Efficiency	Expected Impacts of the Standards on Housing Starts [a]: SMASs "Not Willing to Pay" for Energy Efficiency	Expected Impacts of the Standards on Property Values
No Sanctions, No Incentives	15 to 50% (1982) 15 to 66.5% (2000)	Little change expected if penetration rate is low	Little change expected if penetration rate is low	New houses that comply with the Standards increase in value by 2%
No Incentives Incentives (b)	50 to 60% (1982) 66.5 to 95% (2000)	Slight increase	slight increase	New houses that comply with the Standards increase in value by 2%
Sanctions, Incentives (b)	60 to 66.5% (1982) 90 to 100% (2000)	Slight increase	slight increase	New houses that comply with the Standards increase in value by 2%
Sanctions, No Incentives	50 to 66.5% (1982) 66.5 to 100% (2000)	At most a 1% decrease	At most a 2% decrease	New houses that do not comply with Standards increase in value Older houses increase in value New houses that comply may be priced at a discount

[a]Housing start impacts were calculated assuming a 2% increase in the first cost of housing complying with the Standards.

[b]Incentives are assumed to include a public education program only.

between consumers of different income classes, 2) typical lending practices of financial institutions, and 3) the types of incentives adopted for the implementation program alternatives. Variation in rates of discount will be considered first. The equity implications of this factor is the same for all four alternatives.

The impact of the Standards on individual consumers will vary directly with their rate of discount for future expenditures, which in practice is different for different groups of consumers. The discount rate reflects the rate at which consumers will trade present income for future income.

Work has been conducted that indicates consumer discount rates may vary inversely with income group (Hausman 1979). This implies that lower income groups will not derive as many benefits from the Standards as higher income groups.

The second equity impact of implementing the Standards concerns lending institutions and their mortgage practices. Analysis indicates that some consumers are willing to pay for a significant percentage of the Standards-mandated improvements. On this basis it can be concluded that some consumers do consider building life-cycle costs, and are therefore likely to see no change, or maybe even a decrease, in life-cycle costs due to the Standards. However, it is not clear whether lending institutions will also see the decline in life-cycle costs or whether they will continue to make mortgage decisions on the basis of first costs. If they continue existing procedures, then individuals who fall on the borderline of credit worthiness (typically, individuals in lower income groups) are likely to be priced out of the market. It has not yet been estimated how many people this may affect, but the number appears to be small based on current analysis. The applicability of this second equity impact to the alternatives depends on the penetration rate of the alternative. The greater the penetration rate, the greater the probability of pricing individuals out of the new housing market, assuming no mitigating incentives.

The development and application of any type of incentive requires that funds be derived from one of three sources: 1) existing programs, 2) increased tax revenues, or 3) deficit financing. Obtaining funds from any of these sources would cause an income transfer. With tax credits the income would transfer to purchasers of homes that comply with the standards. Grants and technical assistance would cause a transfer to local governments, builders and designers. Some incentives, such as tax credits or a public information program, have the potential to ensure that no consumer would be priced out of the new housing market as a result of the Standards. The equity impacts related to incentives are applicable only to Alternative 2, No Sanctions--Incentives, and Alternative 3, Sanctions--Incentives.

3.5.2.2 REGIONAL ECONOMIC IMPACTS

This section presents the regional economic impacts of the Standards on earnings and employment for the four implementation alternatives. Because of the methodology used, the percentage change in earnings and employment is always equal. In general, the regional impact on earnings and employment is extremely small, positive and varies very little by region.*

The impact of the Standards on regions varies only slightly by alternative. The impacts of the Standards on 11 selected Bureau of Economic Analysis (BEA) regions for three penetration rates, 20%, 60% and 100%, are shown in Table 3-16. The impacts change very little as penetration rate increases. Table 3-17 shows the regional impact of an implementation program that includes a 100% tax credit (one that returns to the consumer any housing first cost increase caused by the Standards). The introduction of a 100% tax credit has little impact on regional earnings and employment.

3.5.3 COMPARISON OF PHYSICAL ENVIRONMENT IMPACTS

This section presents a comparison of the physical impacts which may result from the four implementation alternatives. The impact of each alternative is determined by using the penetration rates (the range) assigned to each, as discussed in Section 3.3. The section includes a comparison of both energy and natural environments.

3.5.3.1 ENERGY

Direct energy savings as estimated in the ORNL energy demand models are shown by fuel type and alternative in Table 3-18. The energy savings relate to the high and low penetration rates assigned to each alternative. The table provides a comparison of the estimated range of energy savings for each alternative. Alternative 1 provides the lowest energy savings among all four alternatives and within the three fuel types. Alternative 3 is projected to provide the highest savings. The high and low savings are similar for Alternatives 2 and 4. The difference

*The effect of the Standards on employment in locales that produce construction materials used for increasing housing energy-efficiency was not analyzed because the regional impact of such changes is believed to be small. Locales where production of energy-efficient materials is concentrated are shown in Figures 5-1 through 5-3.

TABLE 3-16: PERCENT CHANGE IN EARNINGS AND EMPLOYMENT FOR 20%, 60% and 100% PENETRATION RATES ASSUMING NO INCENTIVES

BEA Region	20% Penetration Rate			60% Penetration Rate			100% Penetration Rate		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
14 New York, NY	0.01	0.02	0.02	0.02	0.05	0.07	0.03	0.09	0.12
52 Huntington-Ashland, WV	0	0	0.01	0	0.01	0.04	0	0.02	0.07
60 Indianapolis, IN	0	0	0.01	0	0.02	0.02	0	0.02	0.03
67 Youngstown, OH	-0.01	0	0.01	-0.02	0	0.02	-0.03	0	0.03
97 Fargo-Moorehead, ND	0	0.02	0.02	0	0.05	0.05	0	0.08	0.08
111 Kansas City, MO	0	0	0	0	0.01	0.01	0	0.02	0.02
128 Killeen-Temple, TX	0	0.01	0.01	0	0.04	0.03	0	0.06	0.05
147 Colorado, Springs, CO	0	0	0.01	0	0	0.02	0	0	0.04
156 Yakima, WA	0	0.01	0.01	0	0.04	0.04	0	0.06	0.06
162 Phoenix, AZ	0.01	0.01	0.01	0	0.03	0.04	0.03	0.05	0.06
171 San Francisco, CA	0	0.01	0.01	0.01	0.02	0.02	0.01	0.03	0.04
Average	0	0.01	0.01	0	0.02	0.03	0	0.04	0.05

TABLE 3-17: PERCENT CHANGE IN EARNINGS AND EMPLOYMENT FOR 20%, 60% and 100% PENETRATION RATES WITH 100% TAX CREDIT

BEA Region	20% Penetration Rate			60% Penetration Rate			100% Penetration Rate		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
14 New York, NY	0.03	0.03	0.03	0.08	0.09	0.10	0.13	0.15	0.16
52 Huntington-Ashland, WV	0.04	0.03	0.02	0.11	0.08	0.07	0.19	0.14	0.12
60 Indianapolis, IN	0.02	0.02	0.01	0.07	0.05	0.04	0.11	0.09	0.07
67 Youngstown, OH	0.01	0.01	0.01	0.04	0.04	0.03	0.06	0.06	0.05
97 Fargo-Moorehead, ND	0.02	0.02	0.03	0.05	0.10	0.08	0.08	0.08	0.16
111 Kansas City, MO	0.02	0.02	0.01	0.07	0.05	0.04	0.12	0.09	0.07
128 Killeen-Temple, TX	0.02	0.02	0.02	0.07	0.07	0.07	0.12	0.11	0.11
147 Colorado Springs, CO	0.02	0.02	0.01	0.05	0.05	0.02	0.09	0.04	0.04
156 Yakima, WA	0.02	0.02	0.02	0.07	0.07	0.07	0.12	0.12	0.12
162 Phoenix, AR	0.03	0.03	0.02	0.09	0.08	0.07	0.15	0.14	0.11
171 San Francisco, CA	0.03	0.02	0.02	0.08	0.06	0.05	0.13	0.10	0.08
Average	0.02	0.02	0.02	0.07	0.07	0.06	0.12	0.11	0.10

between Alternatives 2 and 4 is that Alternative 4 is assumed, based on the institutional analysis, to have a slightly higher initial impact and to provide higher energy savings over the long term.

Net energy savings, which accounts for all energy embodied in conservation materials and other energy consumed that is traceable to the Standards, is about 90% of these direct energy estimates.

3.5.3.2 NATURAL ENVIRONMENT

The analysis of impacts on the natural environment is also based on the penetration rates assumed for each alternative. It is important to note that, on balance, whatever level of penetration results from the implementation of the Standards, beneficial impacts on man's physical environment occur because emissions and energy use are reduced. Furthermore, the faster and more complete the resulting penetration, the greater the beneficial impact. Local increases in emissions due to localized manufacture of energy conserving materials are analysed in Sec 5.3.3. Based on the bounding scenarios, a comparison of the impacts on man's physical environment is summarized in Table 3-19. This provides information for the decisionmaker to weigh these beneficial impacts against the negative impacts on man's environment.

Alternative 1, No Sanctions--No Incentives, is projected to result in the smallest reductions in energy use and pollutant emissions. This is the case because Alternative 1 gives the lowest projected penetration. Therefore, smaller amounts of energy saving materials are produced and

TABLE 3-18: ENERGY SAVINGS (in Quads)

		1985		1990	
Energy Type	Alternative	High	Low	High	Low
Electricity	1	0.100	0.027	0.206	0.0485
	2	0.184	0.100	0.390	0.2060
	3	0.220	0.174	0.455	0.3640
	4	0.220	0.100	0.455	0.2060
Oil & Other	1	0.021	0.0045	0.044	0.0041
	2	0.040	0.0210	0.086	0.0440
	3	0.050	0.0300	0.107	0.0650
	4	0.050	0.0210	0.107	0.0440
Natural Gas	1	0.041	0.0085	0.092	0.0167
	2	0.070	0.0410	0.140	0.0920
	3	0.080	0.0600	0.158	0.1330
	4	0.080	0.0410	0.158	0.0920

smaller savings in energy accrue. The increased emissions associated with building material manufacture are smallest for this alternative as are the reduced emissions because of reduced fuel use. The net result is that the emission reductions are smallest for Alternative 1. The range of impacts for this alternative is given in Table 3-19. The impacts correspond to penetration rates ranging between P_4 and P_5, with the expected rate closest to P_5.

The greatest beneficial impacts are projected to accrue for Alternative 3, which provides both sanctions and incentives. Alternative 3 shows the greatest beneficial impacts because it also provides for the greatest coverage of all new construction. Thus the reduction in energy use and consequent reduction in emissions are greatest for Alternative 3. Thus Alternative 3 would result in greater and faster penetration (and greater beneficial impacts) than Alternative 4, which provides sanctions but no incentives. The magnitude of these increased beneficial impacts would depend on the nature and effectiveness of the incentives.

Alternative 2, No Sanctions--Incentives, and Alternative 4, Sanctions--No Incentives, would result in greater beneficial impacts on man's physical environment than Alternative 1 and fewer than Alternative 3. The impacts of Alternative 2 depend on the nature and effectiveness of the Federal incentives employed. The range of impacts projected for Alternatives 2 and 4 overlaps to a large extent because the extent of penetration. The expected penetration (and consequent beneficial impact) of Alternative 4 is greater than that of Alternative 2.

TABLE 3-19: COMPARISON OF THE PHYSICAL IMPACTS OF THE FOUR ALTERNATIVES

Alternative	Bounding Penetration Scenarios	Energy Saving (gross)[e] in Quads		Reduction in Emissions (tons) of Sulfur Oxide[g]	
		1990[f]	Cumulative Through 1990[f]	1990[f]	Cumulative Through 1990[f]
1. No Sanctions- No Incentives	High - P_5	0.34	1.6	98	820
	Low - P_4	0.07	0.36	21	120
2. No Sanctions- Incentives	High - P_2	0.63	3.0	180	920
	Low - P_4	0.34	1.6	98	820
3. Sanctions- Incentives	High - P_1	0.74	3.6	210	1100
	Low - P_3	0.53	2.7	160	820
4. Sanctions- No Incentives	High - P_1	0.74	3.6	210	1100
	Low - P_4	0.34	1.6	98	820

[a]Expected penetration closest to scenario P_5
[b]Expected penetration mid-range between P_2 and P_4
[c]Expected penetration closer to P_1 than P_3, penetration slightly faster and greater than Alternative 4
[d]Expected penetration closer to P_1 than P_4, penetration slightly slower and smaller than Alternative 3
[e]Electricity converted to primary fuel at a rate of 3.37 Btu (primary) per Btu (electrical). (Corresponds to a heat rate of 10,500 Btu/kWh and a transmission efficiency of 91.3%.)
[f]Chosen as a representative year
[g]Chosen as a representative pollutant

4.0 EXISTING ENVIRONMENT

The baseline environment provides the basis from which to measure the impacts of implementing the Standards. This section presents the methodology used to forecast expected baseline conditions for the institutional, socioeconomic, and physical environment in the absence of the Standards. In addition, the forecasted baseline conditions are presented.

4.1 EXISTING INSTITUTIONAL ENVIRONMENT

The essential institutional actions or responses necessary for implementation of the Standards can be identified from the baseline information. These actions, when viewed within the context of the institutional status quo, allow the identification of potential obstacles to the implementation of the Standards. This provides the background for assessing the likelihood of success, and the likely impacts, of each of the proposed alternatives for implementing the Standards.

4.1.1 METHODOLOGY

Methodologies used to develop baseline information about the institutions at Federal, state and local levels of government likely to be affected by implementation of the Standards are presented, as well as, methodologies used to develop baseline information about the building industry.

4.1.1.1 FEDERAL GOVERNMENT METHODOLOGY

The methodology used in developing the baseline information about Federal programs is described below.

o Federal Buildings

A series of telephone interviews was conducted with officials in Federal agencies responsible for constructing buildings. Appropriate agencies were identified from published sources (Congressional Quarterly, Inc. 1979a).

o Federal Financial Assistance

The present levels of Federal financial assistance (as defined in Section 303 of the Act) were identified for each state and local unit of government from the Office of Management and Budget, Catalogue of Federal Domestic Assistance (OMB 1978).

o Federal Financial Regulation

The Act lists several Federal regulatory agencies that may regulate loans made or purchased by banks, savings and loan associations, and similar institutions, including the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of the Currency, the Federal Home Loan Bank Board, the Federal Savings and Loan Insurance Corporation, and the National Credit Union Administration. Information was collected about the composition, scope (who they regulate), authority, and activities of each of these agencies (Congressional Quarterly, Inc. 1979b).

4.1.1.2 STATE AND LOCAL GOVERNMENT METHODOLOGY

This section summarizes the methodology used to develop the baseline information about state and local government implementation of the Standards. Experiences of state and local governments in adopting and enforcing building codes were reviewed (National Bureau of Standards 1977; Vitale 1979; Seidel 1978; Owens and Braeutigam 1978; Peat, Marwick, Mitchell and Company 1978; City of Portland 1977; Public Technology, Inc, and Harbridge House Management Consultants 1978a,b,c, 1979), with particular emphasis on the thermal efficiency or energy provisions of such codes. All states were ranked and grouped according to: 1) the existence of a mandatory state energy code applicable to a significant fraction of new construction in the state; 2) the percentage of each state's 1970 population in jurisdictions that issued building permits in 1972; and, 3) the average annual rate of population growth in each state from 1970 to 1977. Nine states and 14 local jurisdictions were selected for detailed analysis. The jurisdictions selected were as follows: Arkansas - City of Conway, Pulaski County; California - City of Davis; Colorado - City of Boulder; Florida - Dade County, City of Orlando; Illinois - City of Springfield, City of Schaumberg; Massachusetts - City of Boston; Texas - City of Austin, City of Fort Worth; Virginia - Henrico County; Washington - Kitsap County, City of Seattle. Some were selected because of their experiences with implementing energy codes, others were selected because they had no energy codes.

The analysis included developing a detailed baseline of information about legal, organizational and political obstacles to the adoption and implementation of the Standards and an estimation of the likely state and local responses to the four implementation alternatives. The next

step involved estimating the impacts of the alternatives and the likely compliance responses to the alternatives, on state and local governments. Finally, the analysis focused on developing penetration rate estimates of the Standards, and estimates of the costs to state and local governments of implementing the Standards. Detailed documentation of methodology for collection and analysis of data on Federal, state, and local governments and agencies are included in a support document (Human Affairs Research Center, 1980) to the DEIS Supplement.

4.1.2 DESCRIPTION OF INSTITUTIONAL ENVIRONMENT

This section provides baseline information about Federal, state and local units of government that might become involved in implementing parts of the Standards. Figure 4-1 illustrates the relationships among the organizations involved. Detailed analysis of the existing environment for Federal, state and local governments including state and local case studies are documented (Human Affairs Research Center, 1980).

4.1.2.1 FEDERAL INSTITUTIONAL ENVIRONMENT

The most important information about the Federal baseline environment is the existing enforcement mechanisms by which the Federal government already influences construction of new buildings. Figure 4-1 shows three major ways in which the Federal government exerts control. First, the Federal government itself constructs new buildings. Second, the Federal government provides funding or loan guarantees for the construction of buildings by state and local governments, and private entities and third, the Federal government regulates financial institutions that provide financing for the construction of new buildings. These three means of control are described briefly below.

The value of new Federal buildings constructed in 1976 represented 4% of the value of new buildings constructed during that year (U.S. Dept. of Comm. 1978a). Twenty-four agencies have the authority to construct buildings, of which eight agencies account for the majority of design and construction (Nerheim 1980a).

Sixty-seven programs provide financial assistance to the housing industry. Sixty-four of the 67 programs are run by departments. Refer to Table D-1 in Appendix D for a summary table of the programs affected by MPS, HUD or FmHA. More than half of the programs are controlled by the Department of Housing and Urban Development, and 46% of the expenditures are controlled by HUD. Seven programs are run by the Department of Health, Education and Welfare with 40% of the total expenditures. The remaining 23 programs, accounting for 14% of the outlays, are scattered among seven other agencies. More than half of the programs and 85% of the expenditures are used to provide guaranteed or insured loans.

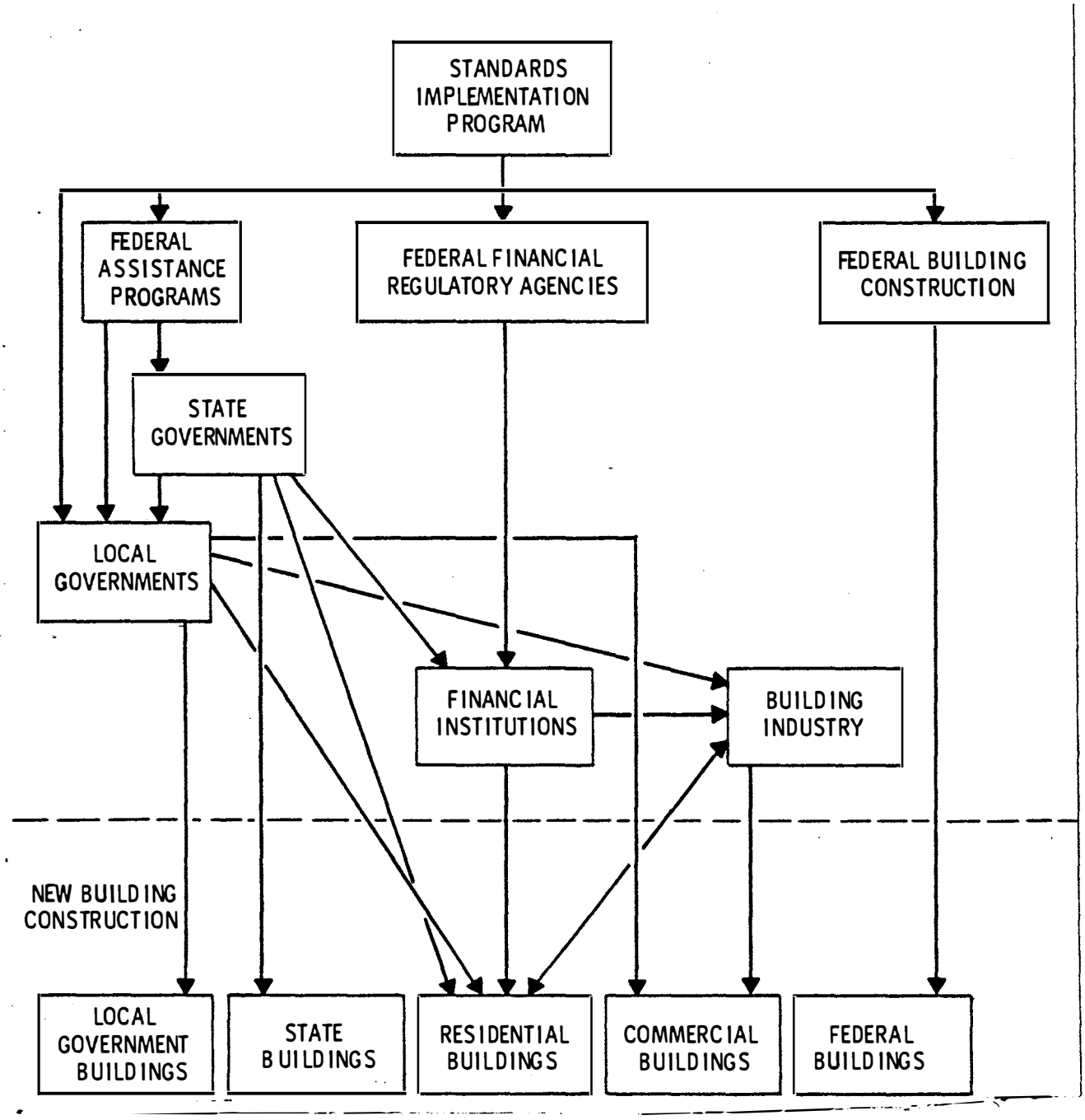

FIGURE 4-1: INSTITUTIONAL SETTING FOR STANDARDS IMPLEMENTATION

Section 303(7) of the Act defines Federal financial assistance to include not only the assistance programs already discussed (Section 303(7)(A)), but also loans made by institutions regulated by "the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of the Currency, the Federal Home Loan Bank Board, the Federal Savings and Loan Insurance Corporation, or the National Credit Union Administration" (Section 303(7)(B)). These six agencies have direct and/or indirect control over the majority of the nation's banking and savings institutions. A variety of regulatory functions are divided among all five and are briefly described in the following sections.

The six agencies mentioned above have direct and/or indirect control over the majority of the nation's banking and savings institutions. A variety of regulatory functions are divided among all six.

Ninety-seven percent of the nation's 15,000 banks are regulated by one of the three following agencies: the Comptroller of the Currency, the Federal Reserve System, and the Federal Deposit Insurance Corporation.

Most U.S. banks fall into one of three categories, National Banks, State Member Banks, and State Non-Member Banks. Regulatory authority is determined by bank type. These three agencies have similar and related regulations governing banking standards, procedures, safety precautions, and unsound practices.

The country's 14,998 commercial banks provide 23% of the funds for new construction. In 1978 banks provided $11,286 million for residential properties. Depending upon the nature and origin of the charter, banks are regulated by one of four agencies, the Comptroller of the Currency, the Federal Reserve System, the Federal Deposit Insurance Corporation, or a state banking agency.

Savings and loan associations are the nation's largest suppliers of funds to home buyers and the residential construction industry. In 1978 savings and loan associations provided $29,641,000,000 for new loans. This is almost three times that of the commercial banks. In general, savings and loan associations are either chartered by the Federal government through the Federal Home Loan Bank Board or by state authorities.

A credit union is a financial cooperative serving individuals having a common occupational, associational, or residential bond. Credit unions are chartered by either the Federal government or state governments. In 1978 there were 22,106 credit unions having total assets of $62,347,964,000 (Nerheim 1979b).

4.1.2.2 STATE INSTITUTIONAL ENVIRONMENT

This section first provides a national overview of the state institutional environment as it pertains to the adoption and implementation of the Standards. It then summarizes impediments to the adoption and enforcement of the Standards by state governments. These impediments were identified by a detailed analysis of nine states selected for in-depth study (Human Affairs Research Center 1980).

4.1.2.2.1 EXISTING STATE INSTITUTIONS

The characteristics identified as important indicators of the ability of state and local governments to successfully implement the Standards are: (1) the existence and coverage of building codes; (2) experience with building energy codes; (3) the level of demand placed on responsible state or local agencies; and, (4) available resources.

It is assumed that state and local governments that already have building codes are more likely to be able to implement an energy code (the Standards) than those that currently do not have codes.

The existence of state building codes, their coverage by building type (National Bureau of Standards), and the level of state participation in administration and experiment of the codes are summarized in Appendix D in Table D-2. The percentage of a state's 1970 population living in jurisdictions that issued building permits in 1972 was used to approximate the coverage of local jurisdictions by state codes. This estimate was used to substitute for the percent of building activity, in a state, occurring in jurisdictions with building codes. While all jurisdictions that issue building permits do not enforce codes, the vast majority do so. (Maxwell 1979) Thus, states with low percentages of population in permit issuing localities are likely to have lower coverage by both state and local codes than those with high percentages.

Currently six states and Washington D.C. have no building energy codes. There is a great deal of variation in the level of state involvement in code administration and enforcement within the 44 states which do have some form of building energy code. The development, adoption and amendment of the standards is a state-level function. Enforcement of standards for state-owned buildings is a state level function. The authority for code enforcement for residential and nonresidential buildings, on the other hand, has generally been reserved for local jurisdictions, as well as the responsibility for enforcing compliance for local government buildings. Where localities have the option of adopting standards or codes that are stricter than the states, or can assume the responsibility for enforcing the state standards, the state may choose to approve the localities' enforcement programs. Many states with mandatory energy codes have indicated that it is not possible to force localities to enforce the state codes, especially in areas where building departments or other enforcement instruments and resources are lacking. Thus, there is a widespread belief that, even in those states with ostensibly mandatory state energy codes, enforcement is by no means uniform across the state.

In states where enforcement is left entirely to the local jurisdictions, state agencies may function in an advisory capacity by helping with code interpretations, conducting reviews of plans submitted voluntarily or by offering technical assistance. Training programs are also developed and administered by or through state offices. While all states with

codes have conducted training programs, they varied greatly in cost and coverage. Table D-3, Summary of State Assistance for Local Code Enforcement in Appendix D is a summary of training programs. State training program costs varied from $1000 to $1 million, while the number of workshops or seminars ranged from two to over a hundred. The numbers and types of participants at these workshops varied widely as well.

The existing demands on a state or local code enforcement agency are likely to be important determinants of its ability to successfully implement the Standards. Demands such as the growth in the volume of construction activity or the increase in complexity of construction are likely to be important in this regard. Recent population growth is an indicator of current demand for local government services (Evans 1979).

The resources of a code enforcement agency include its size, training and experience of the staff, the level of funding and the responsiveness of funding mechanisms to changes in demand placed on the agency. Table D.4 in Appendix D summarizes the characteristics for which information was available at the state level. Twenty states had mandatory state building codes for all construction, and 23 states had no mandatory state building codes. In keeping with the regional origin of these codes, most states in the west and midwest have codes based on the Uniform Building Code, most southern state codes are based on the Southern Building Code, and most northeastern states base their code on the Basic Building Code (O'Bannon 1973).

There is a high degree of correlation between states that have adopted mandatory building codes for new construction and those states that have adopted mandatory energy codes for new construction. Only five states that have adopted or are adopting state building codes have not adopted state energy codes, while 14 states that have adopted state energy codes of some form have not adopted state building codes.

As may be expected, the more highly urbanized states have the largest percentages of population covered by a building code, while the more rural states have the lowest percentages. Geographically, the states with the highest percentages tend to be those of the northeast, northern midwest, Pacific coast and southwest. The states with the lowest percentages are generally found in the south, the southeast, the Great Plains and the northern Rocky Mountains. States with the largest populations had the greatest amount of construction activity during 1976. However, states with a rapid rate of population growth also generally experienced higher levels of construction activity.

4.1.2.2.2 EXISTING IMPEDIMENTS FOR STATE INSTITUTIONS

This section summarizes existing impediments to compliance with Standards by state governments (Human Affairs Research Center 1980).

Interviews with state and local government officials, representatives of the building trades and design professionals indicated several areas of potential impediments to state adoption and implementation.

The most significant constraints on effective implementation of standards or codes appear to be:

o Lack of Previous State Experience

Several states have no jurisdiction over their building industry and others regulate only state-owned buildings. Lack of a code enforcement program, is usually accompanied by lack of an appropriate, or existing agency to take on these regulatory functions. In these states, there is no precedent for building construction regulation, and it can be expected to take considerable time to develop the necessary public support.

Many states with existing energy codes actually have no state role in code administration or enforcement. These states may lack the staff, experience and established procedures necessary for implementing and enforcing a code compliance program or an Alternative Approval Process.

o Political Opposition

States with "home rule" laws such as Texas or Illinois may be legally or politically constrained from taking actions traditionally reserved for local governments at least in "home rule" communities. Enacting a program which includes state approval of local code enforcement programs may be difficult. Historically, only state codes which allow significant local variations and local enforcement authority have passed the legislatures of "home rule" states. In some states which have state energy codes, thers is political resistance to state actions which are necessary for enforcement. For example design professionals may oppose any attempts to increase government regulations of their activities.

o Timing of Compliance

State and local government officials stressed the need for a phase-in period before full compliance (with the Standards) could be achieved. They generally cited 3 to 5 years as a realistic period of time for passage of new legislation and/or amendment to existing codes. In several states, new legislation can be submitted only every two years. Thus, legislative compliance by 1980 would be unlikely in those states with biannual legislatures that met in 1979.

Legislative staff indicated that if there was a deadline on state code adoption prior to the legislature's next scheduled session, the code could be proposed during a special or "emergency" session which may be called at the discretion of the governor. However, a special session required to respond to Federal regulations would be expensive, politically unpopular, and would create opposition to the Standards themselves. Many states that have adopted energy codes have found that, even with state approved education and training programs, it has taken

at least three years for both code enforcement officials and design professionals to learn new skills and routines required for energy code implementation.

o Lack of Funds to Support Compliance Programs

States which do not currently administer building or energy codes expressed reluctance to incur additional state costs for energy code adoption and enforcement. However, if Federal funding was available to support the operation of the state code enforcement program, interviewees felt that state legislatures would be more likely to approve such a program.

Many states have required major agencies to "freeze" or reduce their budgets. The ability of the appropriate agency to grow through the acquisition of personnel and funds to successfully administer an energy code program may be limited by this.

o Lack of Expertise

Training and education requirements of both agency staff and members of the building community and local governments might require technical resources which are currently available only in states with more sophisticated code programs.

Federal assistance could be provided either directly, or by funding state agencies to purchase technical assistance from outside sources.

o Lack of Priority

Energy code adoption and enforcement is a relatively low priority for states compared to other issues. Unless financial incentives or sanctions are provided to encourage establishing and supporting an energy code program, States may not go far beyond enacting enabling legislation and a program of pro forma support.

4.1.2.3 LOCAL INSTITUTIONAL ENVIRONMENT

This section describes the existing institutional environment of local governments and is divided into three parts. The first part estimates the percentage of new construction covered by local energy codes. These estimates were developed to help determine the degree of compliance with the Standards that would be possible. The second section describes the procedures typically used by local governments in enforcing building energy codes. The third section summarizes impediments to the adoption and enforcement of the Standards by local governments in states either that do not have codes or that require only jurisdictions with building permit systems to adopt codes.

4.1.2.3.1 SUMMARY OF LOCAL CODE COVERAGE IN NONCODE STATES AND STATES WITHOUT UNIVERSAL STATE CODE COVERAGE

Within the 17 states which have no statewide building energy codes and the 4 states with codes for public buildings only, many cities and counties have adopted some form of an energy code for new construction, often based on one of the national model codes. The percent of each state's population covered by locally adopted codes is shown on Table 4-1. This table also includes estimates of population coverage in states with statewide codes mandatory only for jurisdictions with building codes, departments, or permitting systems (DOE 1979d).

4.1.2.3.2 CURRENT LOCAL BUILDING ENERGY CODE ENFORCEMENT PRACTICES

A majority of the states studied (Human Affairs Research Center 1980, NBS 1977) play a limited role in enforcing state building/energy codes. A few states such as Massachusetts provide a plan review program for local jurisdictions.

At the local level, building energy codes are enforced through an inspection/permit system by the local building department. Predesign consultations are usually recommended rather than required for commercial structures. As a rule, predesign consultations are not considered necessary for residential structures. Plan reviews are generally performed for both residential and commercial construction. If the plans do not comply with the code, technical assistance is usually offered by the building department to enable the designer or builder to amend the plans to meet the code requirements. Inspections are performed by the building department during the construction phase.

If the inspector discovers a code violation the builder will be notified and a stop work order may be issued. The builder is usually given a number of days to correct the defect. Permits will not be issued until code violations are corrected. Fines for violations are usually provided for in the building code, but the usual practice is to negotiate with the builder to correct any deficiencies before taking punitive action.

The practices discussed above apply to both building and energy codes. Most building department staff members play a dual role as building and energy code enforcers. Energy inspections are performed at the same time as the other inspections. Some jurisdictions have the authority to deny utility hook-ups if the final inspection does not show code compliance. This is a highly effective way of ensuring compliance.

TABLE 4-1: LOCAL CODE COVERAGE IN NONCODE STATES WITHOUT UNIVERSAL STATE CODE COVERAGE

State	Total Population as of July 1, 1976	% of Population Covered
Alabama[a]	3,653,000	50
Alaska[a]	408,000	50
Arizona[a]	2,249,000	0
Arkansas[b]	2,117,000	50
Colorado[a]	2,575,000	87-90
Delaware[a]	582,000	90
Idaho[a]	833,000	51 by specific ordinance 83 to 89 by practice
Illinois[c]	11,193,000	2
Iowa[a]	2,874,000	80
Kentucky[a]	3,436,000	25
Louisiana[c]	3,875,000	10 (14 jurisdictions)
Maine[a]	1,071,000	0
Mississippi[c]	2,365,000	4
Missouri[b]	4,787,000	21 maximum
Nebraska[c]	1,552,000	14
Oklahoma[b]	2,770,000	45 currently 75 by end 1980
Pennsylvania [c]	11,802,000	unknown
Texas[b]	12,599,000	5
Vermont[a]	477,000	0
West Virginia[a]	1,832,000	unknown by state
Wyoming	391,000	43 maximum

[a]Substantial information readily available from states.
[b]Some data available from states.
[c]Inconsistent or little data available.

4.1.2.3.3 IMPEDIMENTS TO IMPLEMENTATION AT THE LOCAL LEVEL

Potential constraints to compliance with local energy standards or codes at the local level are summarized below. Although not all constraints apply in all jurisdictions, several were noted with enough frequency to indicate that they might be major obstacles to implementation at the local level.

o Lack of Funding

Local governments operating on tight budgets indicated they would not be willing to impose additional tax burdens on their constituencies nor would they reduce support to existing programs (such as health and safety) in order to implement energy codes via local code enforcement.

Although many existing building departments are self-supporting, covering
operating costs with revenue generated through application and permit fees, the establishment of an energy code would entail front end costs (training, procedure development and structuring of processing, and support staff) that local governments may be unwilling to shoulder. Thus, there is considerable local reluctance to code implementation unless federal or state funding is available. The funding would be utilized to establish and administer a code enforcement program where none currently exists, or to support the additional work load imposed by addition of energy code enforcement.

o Political Opposition

The two main types of political opposition are: 1) opposition to the imposition of Federal or state requirements on local government, and 2) opposition by local officials to assume regulatory responsibility over the private sector. Many respondents contacted stressed the need for a state code which provided for certification of locally designed and/or adopted programs.

o Lack of Technical Expertise

Both salary levels and total agency staff allocations may make it difficult for building departments to attract and retain highly skilled staff, with the ability to perform technical analyses, plan reviews and inspections that they feel will be required. Building officials felt that the extra technical effort that might be required in order to comply with the Standards might not be met by existing staff without additional training. Training and education requirements of both in-house staff and members of the building community would require technical resources which are currently only available in a few jurisdictions. Thus, local agencies would be reliant upon Federal or state assistance for training and education.

o Low Priority to Energy Conservation

Energy code implementation and enforcement has a low priority in many jurisdictions. Local government officials stated that unless they had outside assistance to support the development and operation of a code enforcement program, implementation would be unlikely. Several building code officials indicated that although their jurisdictions had recently enacted an energy code or were in the process of developing one, they did not expect to be able to enforce the code without additional staff.

o Timing of Compliance

Most local officials felt that a gradual compliance period would be needed by design professionals, building industry and code enforcement officials. This would allow time to learn new techniques and systems. Additionally, phased compliance would foster a more cooperative approach to regulation.

o Lack of Experience with Code Administration

Jurisdictions without any provision for building inspection, or any mechanism for performing such inspections would not be able to assume the enforcement of an energy code program. However, these areas generally have a low population and low growth rate, and may be eligible to be exempted.

o Lack of Authority to Adopt Code

Some local jurisdictions are constitutionally prohibited from undertaking a range of activities, including code adoption and enforcement.

4.1.2.4 BUILDING INDUSTRY GROUP ENVIRONMENT

The building industry consists of a diverse group of professionals and industry groups who are responsible for producing buildings. The professional groups discussed in this section include design, construction, building systems, and material manufacturers. The industry groups discussed are design professionals, professional construction organizations,
and the Manufacturers' Associations.

4.1.2.4.1 DESIGN PROFESSIONALS

Design professionals interact with building clients, financing, real estate, designers, and material manufacturers to coordinate the production of buildings. These interactions are shown in Appendix D, Figure D-1. The building client is the driving force behind the construction activity. Once the need for a building is perceived, its feasibility is tested by examining the potential alternatives to satisfy a client's requirements. This involves finance, real estate and the design professional working together. A plan is developed which is all inclusive from the selection and acquisition of the site through occupancy of the new structure. At this stage a design team is retained consisting of architects and engineers.

For small structures, such as 4-family or smaller residences or smaller warehouses, many local codes do not require plans to be prepared or signed by a licensed professional. Lack of a requirement for a signature, however, does not relieve the designer of the building from the responsibilities of meeting code requirements, or the standard liability included with the construction and use of a structure. The function of a code is to provide protection for the individual and for community health and safety. In most states large and/or complex structures are required to have plans signed by licensed professionals before a building permit can be obtained.

Designers, particularly architects and mechanical and electrical engineers, require a thorough knowledge of energy use in a building and its relationship to building design. This knowledge is required because of state and/or local energy codes and voluntary standards such as ASHRAE 90-75 and also because of the client's demand that the structure be energy efficient.

Approximately 39 states have energy codes and most are ASHRAE 90-75 based. The two ways of meeting these code requirements are either component performance or building performance. Generally the majority of building plans are designed on a component basis. This is perceived to be easier. The component performance code is analogous to most existing codes in that it constrains individual components or subsystems in their size and/or use. A building performance code sets bounds for the entire structure and does not constrain or specify the materials, subsystems or arrangements within the structure. This total building performance approach has few, if any, analogous examples in existing codes. Energy has always been considered a budget item, and designers were requested to project the energy consumption of their designs. This type of information was usually requested for larger and more complex structures. Accordingly there is a basic level of experience in energy conscious design in the design profession.

A small fraction of today's buildings are designed using an overall building performance approach. Many energy analysis methodologies exist. Some are very sophisticated and others are rather simple. They include privately owned and used systems, privately owned and publicly available systems, and still others are publicly owned. They are used to analyze both performance of building components and systems. The introduction of a performance based energy code would require additional work to do the energy analysis according to the requirements of the code.

An energy effective design using the client's criteria may not satisfy the requirements of the code because it is based on different criteria. This raises the following problems. First, is determining what can be optimized in the design. Second, is determining remedies to the design which allow it to comply with the code. Third, is determining the impact of the remedies using the client's criteria. Fourth, is to sell the owner on the solution. This may mean a major redesign and the result may be a suboptimal design from the client's point of view. This brings up the question of whether design teams do energy effective design, given reasonable time and money, or will they simply reduce the living standard in order to overcome the limits on energy use? Design ability is a direct function of experience with energy conserving design and a basic understanding of energy related issues in the design process.

o Registration and Licensing

All states have registration and licensing requirements for architects and engineers. In most states, architects and engineers must pass both qualifying and professional examinations in the architectural or engi-

neering fields and must have certain minimum education credentials and experience. Certification and registration boards for architects and engineers have established uniform examinations used by most states for registration requirements.

The National Council of Architectural Registration Boards (NCARB) prepares uniform architect registration examinations annually (used by all states). A portion of the registration examination, tests the architect's knowledge of energy conservation and utilization. Certification of an applicant as a registered architect by the NCARB aids reciprocal registration arrangements among the different states (NCARB 1978/1979).

The National Council of Engineering Examiners (NCEE) prepares uniform professional examinations in 13 different engineering disciplines (used by most states). Registration of professional engineers (PE status) by the NCEE aids reciprocal registration arrangements among the different states (NCEE 1978).

Nonregistered architects and engineers are able to work in firms with registered architects and engineers but are unable to seal plans. Most states have a 4-year interval between the first (Engineer-in-Training) and second (Professional) engineering examinations required for registration.

4.1.2.4.2 PROFESSIONAL ORGANIZATIONS

The American Institute of Architects (AIA) is the major association for registered architects with groups in every state. Membership consists of corporate members (registered, professional architects) and approximately 1% associate members (nonregistered, apprentice architects) (Encyclopedia 1979a). Usually information affecting architects is disseminated through the semi-monthly "AIA Memo", the monthly "AIA Journal." State and local AIA groups hold workshops on specific topics.

The National Society of Professional Engineers (NSPE) is a major association for professional (registered) engineers and engineers-in-training (nonregistered). The NSPE has groups located in every state and uses these groups to inform members of pertinent information and changes. In addition, there are associations for the different engineering disciplines. Some of these organizations are:

ACEC - American Consulting Engineers Council
AIIE - American Institute of Industrial Engineers
ASHRAE - American Society of Heating, Refrigerating, and Airconditioning Engineers
IES - Illuminating Engineering Society of North America
IEEE - Institute of Electrical and Electronics Engineers

4.1.2.4.3 CONSTRUCTION PROFESSIONS

Builders, contractors, constructors, and developers are involved with the design and construction of many building types. The building construction industry generally tends to be locally oriented, market- and cost-sensitive, and subject to seasonal variations in building construction (Oster and Quigley 1977). These groups often use building plans and technical information supplied by architects, trade magazines, home builders associations, and materials and systems manufacturers and suppliers (ADL 1975; Cntr Gov't Resp 1975; NAHB 1978). Builders, contractors, constructors and developers are responsible for most of the residential construction (ADL 1975, NAHB 1978). Because of the variety and diversity of building projects, their mode of operation, and their specialties in the construction profession, generalizations are difficult to make (ADL 1975). The National Association of Home Builders has sponsored seminars on energy conservation for the last several years (NAHB 1979a). This continuing educational effort is directed at the approximately 109,000 NAHB members responsible for building approximately 85% of the single-family residences.

4.1.2.4.4 PROFESSIONAL CONSTRUCTION ORGANIZATIONS

There are a number of building and construction organizations, including the National Association of Home Builders (NAHB), American Institute of Constructors (AIC), Associated General Contractors (AGC), Associated Specialty Contractors (ASC), American Council for Construction Education (ACCE), Associated Schools of Construction (ASC), Associated Builders and Contractors (ABC), and American Subcontractors Association (ASA). Newsletters, journals, regional meetings, and workshops are major ways in which these associations and societies acquaint the construction trades with new standards, materials, and techniques in the building industry (NAHB 1979b).

4.1.2.4.5 BUILDING SYSTEMS AND MATERIALS MANUFACTURERS

Manufacturers of systems and construction materials, test, label, and certify their products as required by Federal agencies and consumer groups. The technical data contained in labeling information are often used by design and construction professions for determining a product's use and its resultant building efficiencies (thermal, mechanical, lighting).

Through advertisements, information pamphlets, salesmen, and labeling information, the manufacturing industries are able to introduce and acquaint design professionals and construction trades with their products. The professions rely on this information when making construction substitutions. Manufacturers also develop and publish other information to assist the design professions in applying building standards (PCA 1976, 1979).

4.1.2.4.6 MANUFACTURERS' ASSOCIATIONS

Manufacturer associations provide services to individual manufacturers. These services include developing standards for production specifications of manufactured products and product testing procedures. Institutes such as the Air-Conditioning and Refrigeration Institute (ARI) and Home Ventilating Institute (HVI) test and certify or rate the performance of similar products produced and tested by different member manufacturers. These institutes have developed standards that specify rating procedures.

Other manufacturers groups make proposals for new product testing. The product and proposal are sent to groups such as the American National Standards Institute (ANSI), American Society for Testing Materials (ASTM) or other similar testing laboratories for standard promulgation.

Organizations responsible for testing, certification, rating, or development of standard procedures include:

- American National Standards Institute (ANSI): The Institute is a clearinghouse for nationally coordinated voluntary safety, engineering, and industrial standards. American National Standards status is given to projects developed by agreement among all groups concerned in the areas of procedures and methods of rating; methods of testing and analysis; and practice, safety, health and building construction (Encyclopedia 1979b). ANSI standards have been developed for determining building area, for construction of buildings, and for specific materials used in buildings (ANSI 1977).

- Air-Conditioning and Refrigeration Institute (ARI): The Institute has established consensus standards as requirements for testing, rating, performance, and safety of products; methods of testing; and operating conditions. ARI has 10 standards with an active certification program.

- American Society for Testing Materials (ASTM): The Society establishes voluntary consensus standards for materials, products, systems and services, and has developed more than 6,000 standard test methods, specifications, and recommended practices now in use (Encyclopedia 1979c). ASTM compiled all ASTM

Standards on materials used in building construction in a 1978 publication that contained over 514 specifications and methods of testing and 205 new or revised standards (ASTM 1978-1979).

- Consumer Products Safety Commission: The Commission develops uniform safety standards for consumer products and has primary responsibility for establishing mandatory product safety standards to reduce unreasonable risk of injury to consumers from consumer products.

- Department of Commerce (DOC): The DOC operates several programs that include studies 1) relating the ability of the insulation industry to meet construction and public demands, 2) conducting a voluntary insulation labeling program with some performance criteria (with the Federal Trade and Consumer Products Safety Commissions, and 3) developing a national voluntary membership laboratory program for insulation.

- National Bureau of Standards (NBS): The Bureau is an agency of the DOC that cooperates with Federal agencies, private industry, and regulatory groups to set codes and standards and to establish testing and certification programs. NBS is involved in over 1500 projects aimed at dealing with energy conservation and research, consumer product safety, and fire protection and prevention.

4.2 EXISTING SOCIOECONOMIC ENVIRONMENT

The socioeconomic baseline environment provides the basis from which to measure impacts of implementing the proposed Standards. This section presents the methodology used to forecast the baseline scenario for industry, employment and employment income, as well as a brief description of that baseline environment for both the national and regional economies in the absence of the Standards.

4.2.1 METHODOLOGY FOR PROJECTING THE NATIONAL ECONOMY

The method used to establish the economic forecasts and to analyze the impacts of implementing the Standards is based on the national econometric input-output model, EXPLOR-MULTITRADE (EXPLOR). The EXPLOR model uses a traditional national input-output accounting framework that describes the interrelationships among various producers and consumers of commodities. Figure D-2 in Appendix D illustrates schematically the

accounting relationships in the model; that is, interindustry flows, the components of gross national product (GNP), and value added by producer (i.e., income, profits, etc.), and how they relate to each other. This methodology is described in detail in Appendix E of TSD No. 8, Economic Analysis, in support of the NOPR for the Standards (DOE 1979c).

The EXPLOR model measures production, employment, employment income, energy use, and investment by producing sectors. This model is used in conjunction with the Oak Ridge National Laboratory's (ORNL) Residential Energy Use model and Commercial Sector Energy Use model. These two energy use models are described in detail in Appendix G and H of the TSD No. 8, Economic Analysis, for the Standards program (DOE 1979c). Energy use calculations and capital expenditures related to given policies are estimated in the ORNL Energy Use models and are fed into the EXPLOR model to interact with the rest of the economy. In deriving the baseline projections, policies which exist or are expected in the future are factored into ORNL's models to provide a forecast in the absence of the Standards.

Specificially, the Residential Energy Use model in Figure D-3 in Appendix D recognizes three fuel types (electricity, oil and others, and natural gas); eight end use types (space heating, air-conditioning, water heating, refrigeration, food freezing, cooking, lighting, and other); and two housing types (new and existing). Residential energy use is computed for each energy component based on housing stocks, new construction, fuel price and initial cost relationships for equipment and structures. Various demographic, economic and technological features are considered in the residential energy use simulation.

The ORNL Commercial Sector Energy Use model projects energy use and capital costs of energy-using equipment and structures. Projections are made for three fuel types (electricity, oil and others, and natural gas); five end uses (heating, cooling, water heating, lighting, and others) by 10 building types (retail-wholesale, office, auto repair, warehouse, education, health, public, religious, hotel-motel, and miscellaneous). Like the Residential Energy Use model, the Commercial Energy Use model is based on demographic, economic and technological factors. The information is modified for each year of the simulation to model changes in stock and efficiency of energy-using equipment, operation of buildings and choice of fuel type for space and water heating.

Figure D-4 in Appendix D depicts the interrelationships and information flow of all the models used in the present analysis of baseline and impacts of the proposed energy performance standards for new buildings.

4.2.2 DESCRIPTION OF THE NATIONAL ECONOMIC ENVIRONMENT

Important macroeconomic variables such as GNP, total private consumption expenditure (PCE, a major portion of GNP), total production, investment

requirements, employment and employment income that are projected as described in the preceding section are displayed in Table 4-2. More disaggregated estimates pertaining to production and employment in specific industries are described in the following sections. A forecast of energy use in the baseline is also provided.

4.2.2.1 INDUSTRY

Baseline forecasts generated by EXPLOR, for 80 sectors, include estimates of production, employment and employee income. Those sectors that are expected to feel major impacts from the Standards are displayed in Table 4-3, along with estimated annual production in 1980, 1985, and 1990 assuming no Standards. These sectors are: electricity and natural gas; distributive trade and services; building construction and electric appliances sectors; and finally, some of the material-producing sectors such as rubber and plastic, cement, and log and sawmill products.

Construction forecasts for residential, commercial and mobile homes are an integral part of the ORNL Energy Use model. Detailed impacts of the Standards' program on building materials forecasts were developed in Chapter 6, TSD No. 8, Economic Analysis (DOE 1979c). The forecasts of the impact on building materials were adjusted to be consistent with the ORNL construction forecasts by using separate adjustment factors for residential and commercial buildings. Adjustment factors, as well as the ORNL construction forecasts, are shown in Table D-5 in Appendix D.

At a more detailed level, building material suppliers that were projected to be affected by implementation of the Standards were examined. These industries have been discussed in detail in Chapter 6 and Appendix F of TSD No. 8, Economic Analysis (DOE 1979c), in support of the NOPR. The baseline building material demands for selected materials in the absence of the Standards are shown in Table D-6 in Appendix D. The table includes the effects of present trends in conservation practice for new buildings. Additional conservation activities occurring in response to future higher fuel prices are not included in these baseline estimates. These, therefore, tend to understate baseline demand and overstate any impacts of the Standards.

4.2.2.2 EMPLOYMENT AND EMPLOYMENT INCOME

Employment and employment income (i.e. earned income) by producing industries are estimated in the EXPLOR model in the Wigley Production Function submodel (Figure D-4). In forecasting labor requirements, the Wigley Production Function considers changes in productivity (output/labor) resulting from improvements in productivity of new capital and labor relative to old capital and the existing labor force. Employment

and employment income by selected sectors are listed in Tables D-7 and D-8 in Appendix D.

TABLE 4-2: KEY ECONOMIC INDICATORS

Indicator	1980	1985	1990
Gross National Product (Billions of $1970)	1,369.0	1,635.6	1,896.3
Total Production (Billions of $1970)	2,746.0	3,279.8	3,769.8
Total Private Expenditure (Billions of $1970)	896.0	1,045.0	1,224.7
Investment Requirement (Billions of $1970)	126.8	189.7	193.6
Employment Income (Billions of Current $)	1,508.6	2,879.2	4,275.1
Employment (Thousand Jobs)	106,036	116,249	121,807

TABLE 4-3: ESTIMATED BASELINE TOTAL PRODUCTION BY SELECTED SECTORS

	Millions of 1970 Dollars		
	1980	1985	1990
Electricity	43,923	52,363	60,662
Natural Gas	18,819	19,694	19,088
Building Construction	88,537	103,468	107,825
Electric Appliances	24,053	32,668	36,266
Distributive Trade	296,887	356,155	414,989
Services	823,729	947,485	1,098,332
Rubber and Plastic Products	36,206	44,748	51,919
Cement	17,592	21,267	23,343
Low and Sawmill Products	12,306	15,148	17,127
Total - All Sectors	2,745,954	3,279,844	3,769,756

SOURCE: BNW-EXPLOR Model Base Case for 1980, 1985, and 1990.

4.2.3 DESCRIPTION OF THE REGIONAL ECONOMIC ENVIRONMENT

Several regional economies were examined to determine how total earnings and total employment would change between 1980 and 2000 in an economy without the Standards. The Bureau of Economic Analysis (BEA) has divided the United States into 173 regions. Each region contains at least one SMSA. Eleven (11) BEA regions were examined in this analysis and their statistics are summarized in Table D-9 in Appendix D. A map showing the location and size of these regions is provided in U.S. Water Resources Council (U.S. Water Resources Council 1974).

These 11 regions were selected because of a priori hypotheses that these regions would reflect the range of any economic impacts caused by the Standards. It was hypothesized that several key regional variables would determine the regional economic impacts of the Standards on earnings and employment. These variables include total population, population growth rate, per capita income and energy prices. The 11 regions selected represent the range of values on the impact-determining variables described above.

The methodology used to determine the baseline earnings and employment figures is described in U.S. Waters Resources Council (U.S. Water Resources Council 1974). Table D-9 shows, for the baseline economy, the projected changes in earnings and employment for these regions. Huntington-Ashland, West Virginia shows the smallest growth in earnings and employment. Phoenix, Arizona shows the largest growth. This baseline information was derived from U.S. Waters Resources Council (U.S. Water Resources Council 1974).

4.3 EXISTING PHYSICAL ENVIRONMENT

The most important changes in the physical environment caused by the Standards relate to resource use and pollutants produced during the manufacture of building materials. This section briefly looks at the existing environment and the projected baseline for energy use and pollutant releases.

The methodology used to develop the baseline physical environment is presented and discussed in TSD No. 7, Draft Environmental Impact Statement (DOE 1979a). Energy use in the baseline forecast is estimated in the ORNL energy demand models (see below).

4.3.1 ENERGY USE

The ORNL's Residential Energy Use and Commercial Energy Use models, presented in detail in TSD No. 8, Economic Analysis (DOE 1979c), provide the baseline forecasts of residential and commercial energy use by three fuel types (electricity, oil and others, and natural gas). Energy use by fuel type is estimated in physical units (quads of Btu). The resulting baseline forecasts are given in Table 4-4, which provides detailed information on energy consumption for residential uses and commercial uses by fuel type (in physical units).

4.3.2 DESCRIPTION OF NATURAL ENVIRONMENT

The baseline natural environment which exists in the absence of the Standards provides a basis from which changes due to the proposed action, and reasonable alternatives, can be compared. That baseline was developed in TSD No. 7, Draft Environmental Impact Statement (DOE 1979a). Rather than repeat this discussion on the projected baseline without the Standards, the reader is referred to the DEIS for the Standards for further information. This section summarizes information on the building material manufacturing and energy conversion sectors relevant to how they will be affected by implementation of the Standards. The baseline is assumed to stay the same between both EISs. It is the level of implementation which will determine the impacts on the natural environment.

The DEIS for the Standards identifies industries (including utilities) which may affect the natural environment under a Standards implementation program. This chapter provides background on the type and level of pollutants currently produced by these industries. The analysis has focused on two major types of industries, building material manufacturing and energy conversion. The building material sector includes the following manufacturing industries: insulation, heating, ventilating and air conditioning; siding, flat glass, and softwood lumber. The energy conversion sector addresses the generation of electricity at coal-fired and nuclear power plants, and the combustion of fuel oil and natural gas within the building boundary.

The DEIS for the Standards also discussed impacts on habitability and outdoor site alterations. The section on building habitability addressed existing environmental problems associated with insulation materials, illumination and HVAC equipment. Outside site alterations included modifications to landscape, topography, drainage patterns and the effects of impermeable or reflective surfaces when used as energy-conserving strategies.

Changes in market forces such as energy prices and resource availability cause a continuous and gradual change in the natural environment. These forces determine the use of resources and energy conserving strategies. Thus, as energy prices escalate, consumers tend to demand more energy-conserving materials and utilize energy-conserving strategies to a greater extent. The baseline information used in this assessment is assumed to change over time.

TABLE 4-4: ENERGY CONSUMPTION FOR RESIDENTIAL AND COMMERCIAL BUILDINGS

	Residential Energy Use (Quads)		
	1980	1985	1990
Electricity[a]	9.05	10.86	12.60
Oil and Others	2.81	2.70	2.65
Natural Gas	5.23	5.01	4.92
Total	17.09	18.57	20.17

	Commercial Energy Use (Quads)		
	1980	1985	1990
Electricity[a]	5.25	6.64	7.45
Oil and Others	1.63	2.20	2.24
Natural Gas	3.03	2.05	2.15
Total	9.91	10.89	11.84

[a]Electricity is measured in terms of primary fuels (11,500 Btu/kWh).

5.0 IMPACTS OF SPECIFIC ELEMENTS OF AN IMPLEMENTATION PROGRAM

The purpose of this chapter is to describe the impacts that would occur for various levels of each of the elements of an implementation program. Chapter 3 described how the impacts of the Standards vary by four specific assumed implementation alternatives. However, DOE has not yet settled on the implementation scenario for the Standards and the action chosen may vary from one of the four implementation alternatives described in Chapter 3. Therefore, to the extent possible, impacts by program elements are presented here so that the impacts associated with all potential implementation programs can be estimated.

Socioeconomic and physical environmental impacts are directly related to the speed of adoption of the Standards and only indirectly to the implementation program, per se. Institutional impacts, on the other hand, are equally dependent on both the rate of adoption, and the implementation program developed to achieve adoption. Socioeconomic and physical environmental impacts were, for the most part, related only to the rate of adoption of the Standards (i.e., penetration rates).

5.1 INSTITUTIONAL IMPACTS

This section discusses the impacts of implementation on a program component basis and possible variations that may exist within an implementation program. Section 5.1.1 discusses impacts on government institutions; section 5.1.2 presents impacts on building industry groups.

5.1.1 GOVERNMENT IMPACTS

The impacts on governmental institutions are described in this section. The Federal, state, and local impacts of components of an implementation program (i.e., ways to comply, actions to encourage compliance, tools to encourage compliance) and variations to sub-elements of these components are discussed.

5.1.1.1 WAYS TO COMPLY

Federal compliance, independent of the implementation program is required by Section 252 of NECPA and Section 306 of the Act. State and local compliance would depend upon the implementation program. Two major issues determined by the administering agency are important, 1) whether the program is voluntary or mandatory, and 2) whether control of the program will reside with the Federal government, state and local government, or both Federal and local jurisdictions.

The ability of state and local jurisdictions to comply with the standards is dependent upon energy code adoption, level of demand, and percentage of enforcement coverage. Although 44 states have adopted some form of energy code, this may not be an accurate indication of ability to comply with the Standards (see Table D.2 in Appendix D). However, the six states, and D.C., that have no type of energy code are a clear indication of inability to comply. Thus, states were categorized as states with a state energy code, and those without. Table 5.1 summarizes the findings. There is a clear correlation between ability to comply with energy standards and the existence of building codes. However, 14 states have adopted an energy code in some form, but have not adopted a building code.

The level of demand is an indication of which states are being affected by construction growth. It is used in the analysis to indicate which states would probably have the most construction in the next 5 to 10 years. Table 5.1 indicates in summary form how states are classified under code/demand parameters. Category 3, no state energy code and high demand, includes 11 states and is an initial indication of where implementation of the Standards would be most effective.

The percentage of coverage by a local code in states with no energy code indicates an ability to comply via enforcement. The highest percentage of coverge is in the Northeast, North Midwest, Pacific Coast and Southwest portions of the U.S. The lowest percentage of coverage is in the South, Southeast, Great Plains and Northern Rockies. Most of the states that have no state energy code or only have a code for public buildings are also not achieving enforcement at the local level (14 of 17).

The level of enforcement then becomes the key to compliance. Table 5.1 only indicates which states have adopted an energy code; it cannot be used to determine the success of enforcement under the Standards because, generally, code enforcement is a responsibility of local government. Twenty states have mandatory state building codes for all construction. Eighty percent (80%) of construction is also being influenced by some form of an energy code. These figures and the case study analysis documented in Technical Support Documents to this Supplement (Human Affairs Research Center, 1980) indicate that there is wide variation in the level of enforcement, both in building codes and energy codes. Adoption and administration do not then provide a clear indication of enforcement under either a certification process or an AAP.

TABLE 5-1: EXPERIENCE OF STATES WITH BUILDING CODES AND AMOUNT OF NEW CONSTRUCTION

Category	Experience/Level of Demand	States	Total
1	SEC/HD	(CO), NM, NV, UT, CA, WA, FL, (AR), NH, OR, HI, VA, SC, MT, NC, GA, TN	17
2	SEC/LD	WI, CT, MA, MI, NJ, NY, RI, MN, OH, MD, KS, IN, ND, SD, (DE), (IA)	16
3	NSC/HD	AZ, ID, TX, ME, OK, AK, LA, MS, WY, KY, VT	11
4	NSC/LD	IL, PA, AL, WV, MO, NB	6

Parentheses indicate states with mandatory codes only for jurisdictions with building departments.

SEC = State Energy Code
NSC = No State Code, or code for public buildings only
HD = High Demand
LD = Low Demand
- = Less than 50% of construction in state is covered by local code enforcement

5.1.1.1.1 FEDERAL COMPLIANCE

The impact of Federal compliance involves three Federal requirements or activities: revision of standards, Federal-assisted mortgages and Federal building.

o Revision of Standards

Section 252(b) of NECPA (Pub. L. 95-619, 42 U.S.C. 1471-1490h) directs the Secretary of Agriculture to establish similar MPS for newly constructed residential housing assisted under Title V of the Housing Act of 1949 and directs that "such property standards shall, insofar as is practicable, be consistent with the standards established pursuant to section 1735f-4 of Title 12 and shall incorporate the energy performance requirements developed pursuant to such section" (42 U.S.C. 1490i). DOE has interpreted these provisions to mean that MPS apply to all subsidized and federally insured housing programs and that MPS must be revised to meet the Standards upon promulgation. Some analysis must be completed to revise MPS, as MPS is based on the ASHRAE 90-75 component-

based code. DOE is presently conducting the analysis so that MPS can be revised in a timely manner with the promulgation of the Standards. A full revision and analysis of the component-based code will increase the level of impact upon the implementing agency, and reduce the impact of compliance at the State and local level.

o Federal-Assisted Mortgages

The decentralized approach to implementation specified in Section 252 of NECPA would require that each agency ensure that buildings constructed under the subsidized federally insured housing programs complied with the Standards. Standards such as HUD's MPS would need to be revised, and Federal agencies sponsoring such programs would be unable to assist any new construction that did not comply. Of 67 programs which provide financial assistance, HUD is responsible for 58%, which account for 46% of the Federal financial assistance expenditures. The impact of requiring federally assisted construction to comply is significant in the residential sector as 98% of the Federal funds are assigned to residential programs and 85% of the expenditures are used to provide guaranteed or insured loans. Construction-assistance programs that are subject to the MPS under the Farmer's Home Administration would also be subject to the provisions of Section 252 of NECPA. With specific sanctions as approved by Congress, these programs would not be able to assist new construction in areas not conforming to the implementation program.

o Federal Building

Section 306 of the Act specifies that all Federal agencies responsible for the construction of any Federal building shall adopt such procedures as may be necessary to ensure that any such construction meets or exceeds the Standards. Thus, all Federal buildings would be required to comply. Federal buildings represent approximately 4% of the new buildings constructed each year. Whether Federal agencies update and enforce the Standards for Federal buildings in a centralized or a decentralized way would determine how Federal compliance would affect implementation. A strategy of centralizing enforcement responsibility for Federal buildings in one Federal agency would likely have several impacts. First, other Federal agencies may resist relinquishing authority over one aspect of their new buildings to another agency. Eight agencies--GSA, DOD, NASA, USPS, VA, HUD, HEW, and DOE--account for 98% of all Federal construction activity. Resistance is likely to be particularly strong in DOD, which traditionally has retained complete authority over its own construction projects by successfully arguing that national security justifies that authority. Second, although centralized enforcement authority may result in a higher level of actual compliance with the Standards, it would probably increase Federal paperwork and delay those agencies constructing new buildings.

5.1.1.1.2 CERTIFICATION PROCESS

The impact of a certification process would initially be determined by the energy budget levels of the Standards. A budget level that requires less energy efficiency would require fewer changes in building practice and thus, would make it easier for state and local governments to adopt or enforce an updated code or an existing code. A set of budgets that requires more energy efficiency than proposed in the Standards may mean building practices would change significantly. The full impact of those changes would be determined by the marketplace and available technology. The effect of varying the budget levels has been analyzed in the DEIS for Standards development (TSD NO.7) under the section entitled Alternatives to the Standards.

Three elements unrelated to budget levels are likely to affect state and local impacts of implementing the Standards: 1) the stringency of technical criteria for determining certification, 2) the content of codes, and 3) the procedural requirements for Federal code qualification. The range of state, local, and other institutional impacts likely to result from these elements is outlined below.

o Stringency of Technical Criteria

Technical criteria for code qualification (equivalency) may vary along a number of dimensions. Two important dimensions for local and state implementation are the variation of climate within a jurisdiction and the number of building types. Federal requirements that state or local codes embody separate provisions for different climatic conditions could have severe impacts in those jurisdictions that include a number of such variations. The state or local building department would be faced with the complex and confusing task of essentially enforcing two or more codes. Similarly, builders would have to comply with a number of energy codes within a given jurisdiction. To do this, builders, especially those of small structures, would have to rely much more heavily on design professionals than they do currently, and in general, they would have to devote more time and effort to code equivalency. This, in turn, is likely to result in increases in the cost of constructing new buildings.

A Federal requirement that energy codes be formulated in terms of the Standard's building classification scheme would also increase the complexity of the task facing designers, and state and local code enforcement agencies. The impacts of this requirement are likely to be less severe than the climatic considerations discussed above.

The stringency of technical criteria could seriously affect Federal, state and local governments. If stringent compliance criteria are adopted, more administrative appeals and judicial challenges by the states and localities can be expected. These challenges would require the Federal agency or agencies promulgating the regulations to defend themselves and the validity of their actions. Stringent criteria will

discourage most, if not all, states and local governments from attempting to adopt and implement codes which comply. A code adopted that meets stringent criteria would probably require major changes both in standard operating procedures and in the staffing of most local and state code enforcement agencies, and would probably cause state and local governments and the building industry to strongly oppose implementation of the Standards. That opposition might jeopardize the entire standard.

o Content of Codes

One of two types of codes can comply with the criteria of the Federal administering agency: a pure performance code that meets or exceeds the Standards or a code that has been prequalified by the Federal government. Under a pure performance code, each building would have to be evaluated separately, a process that would be complex, costly and time consuming. Whether these evaluations were conducted by the building department itself or by a licensed design professional, the builder would often bear increased costs for building design and review, and would be delayed in the design and review process. The cost of design and review under a pure performance code would probably lead most builders to rely on a cheaper, less time-consuming approach: using approved building designs rather than developing innovative energy-efficient designs.

State and local jurisdictions would find it easier to adopt prequalified codes that did not contain a performance option. However, this might have a negative effect on innovation in building design, because designers wishing to use a performance approach might be required to use a time-consuming, two-stage design. To establish a design energy budget, the building would first have to be designed according to the component prescriptive path allowed by the code. It would then have to be redesigned so that energy consumption of the new design meets the budget's specifications.

o Procedural Requirements

As currently envisioned procedural requirements for determining equivalency of a code are clearly defined. A code can be qualified to comply with the standards via one of three paths: 1) it can be a pure performance code; 2) it can be a code that has been prequalified by the Federal government; or 3) the states can submit specific information on a candidate code to the Federal administering agency which would determine equivalency of the code.

Alternatively, the Federal government could choose to begin implementing the Standards without specific procedural requirements for qualifying state and local codes. This would spare the Federal government the initial time and expense of developing and reviewing the requirements. But, without a well-defined procedure, the government would open itself to inconsistency and could jeopardize compliance, as decisions could be made that differed from state to state. The process would require that each and every code submitted be reviewed for

qualification. During what would most probably be a lengthy and confusing process, procedural requirements would almost surely evolve. As they did, state and local governments would lose the flexibility they initially had in applying for code qualification, as requests for additional information from the Federal government required more and more time and effort. Further, some states might find the lack of established procedures ambiguous and confusing, and thus delay action on state and local code qualification until well-defined procedures had evolved. Others, citing Federal confusion or uncertainty, might attempt to qualify a code which does not meet the Standards.

5.1.1.1.3 ALTERNATE APPROVAL PROCESS

The availability of an AAP based on designer determination would greatly facilitate state and local government compliance with the Standards. As discussed in Chapter 3, the AAP process would make minimal demands on state and local governments. The AAP creates less demand than the certification process, as the AAP is based on designer and builder affidavits for compliance.

Lack of an AAP could have important negative impacts on state and local governments, particularly if accompanied by sanctions. Local governments would be required to choose between establishing an energy-code enforcement process or allowing the state to establish such a process. Many smaller local governments currently have neither the staff, the experience nor other resources to undertake code enforcement activities. That is, choosing this route would require jurisdictions with no existing code experience to spend considerable time and money to implement the enforcement process. It would require hiring new staff, establishing new rules and procedures, training both old and new staff, and providing staff with necessary office space and materials. The other option would be for the local jurisdiction to allow the state to assume responsibility for implementing and administering an energy code. In many areas, the state's enforcement of building codes could be politically unpopular. Further, if a number of local jurisdictions did allow the state to establish and administer such a process, the state might have inadequate staff and resources for review and inspection.

5.1.1.1.4 UTILITY REGULATIONS

A number of Federal impacts are likely to result from the development and implementation of a Utility Compliance Program. First, a Federal Utility Compliance Program would add to the number of agencies that designers or builders would have to deal with in meeting all building-related requirements of the Standards. Second, Congressional

action would be required to authorize the program's development. Many utilities would probably strongly oppose legislation based on three key issues. First, the utilities would likely argue that enforcing the Standards by denying service would conflict with their traditional, often statutory, mandate: providing timely and adequate service to all who need it. Second, they are likely to oppose the additional administrative burden involved in enforcing the Standards, both in terms of the paperwork involved and the possibility that they might incur liability for the noncompliance of a building that had once been certified. Opposition on this latter point will be particularly intense if proposed Federal regulations require that they actually enforce compliance by conducting plan reviews and building inspections. Third, organizations representing the consumers served by utilities may oppose this method of enforcing the Standards.

If Congress did authorize a Utility Compliance Program, DOE would probably be responsible for its development and implementation. Development of the necessary regulations and the analyses required to support them could involve considerable time and expense, as would possible challenges to the regulations once they were promulgated.

A Utility Compliance Program would affect state governments most directly if Federal regulations required that the state utility commissions exercise their control over utilities in implementing the program. That requirement may be opposed because of the time and expense involved in developing and enforcing such regulations and because it would conflict with the commissions' basic goals. In some states, however, enforcement of the Standards through the utility commissions might be politically more feasible than developing a state energy code, because governments have traditionally regulated utilities, while local governments have enforced building codes.

5.1.1.2 ACTIONS TO ENCOURAGE COMPLIANCE

An implementation program can contain actions that encourage compliance, such as incentives, sanctions, exemptions, monitoring and updating. Incentives heighten the ability and desire of state and local governments to comply; sanctions ensure compliance; exemptions assure fairness by weighting costs to benefits; monitoring determines the level of compliance; and updating ensures effectiveness and energy savings.

5.1.1.2.1 INCENTIVES

Incentives, such as grants and technical assistance, are generally considered to have positive impacts. Among the identified positive

impacts are the increased fuel savings, increased benefits to building owners and speedier construction of buildings that comply with the Standards.

o Technical Assistance and Grants

Sponsoring a large number of state and local grants, technical assistance, education, training and demonstration programs would place great demands on the resources of the Federal administering agency. However, if the programs are well focused, they are likely to lead to swifter compliance and, in the long run, reduce the need for continuing grants and technical assistance. Grants and technical assistance also lend a mechanism for integrating information programs. To be most effective, these programs should be directed to state and local officials, lending institutions, and design professionals, who would benefit most from information regarding the Standards and who would directly influence implementation of and compliance with the Standards.

Education and training programs would be needed most in areas without any building codes, such as cities in regions with a rapidly growing population and building construction volume, where lenders and others are not familiar with the financial benefits of energy conservation. Those areas least likely to require technical assistance or training are those that have previously adopted and are enforcing a building energy code, particularly those areas with codes that include performance options. Limiting Federal assistance to particular kinds of jurisdictions may have negative political impacts. If Federal assistance is provided only to those areas currently without energy codes, other areas are likely to argue that they are being penalized for having taken actions to promote energy conservation.

Determining an adequate funding level for implementation grants is complicated by a number of factors. Up to a point, high levels of funding for implementation would tend to encourage greater compliance by assisting the states in adopting and enforcing the codes. Extremely high grant levels, however, would not be cost-efficient and would likely be viewed by the public and Congress as a waste of the taxpayer's money. On the other hand, if no Federal implementation grants are provided, most state and local governments are not likely to attempt to implement the Standards. In that case, compliance would be achieved through the alternate approval process. If an inadequate level is provided, state and local governments, and the general public might doubt the Federal government's commitment to implementation of the Standards. Those states that adopted energy codes under DOE's State Energy Conservation Program might be resentful, since their existing codes would not meet or exceed the Standards.

The administering agency could minimize criticism with a policy of treating all applicant jurisdictions equally, perhaps on the basis of the number or value of building permits issued in a jurisdiction. However, such a program would be less cost-effective than "targeting" the grants to jurisdictions, even though a targeted program would involve additional effort on the part of the administering agency in

developing a politically and legally acceptable formula for awarding the grants. A grant program that provides aid to all applicant jurisdictions but targets aid to those without code experience or those with rapid increases in construction levels may be the most politically feasible.

o Tax Credits

Tax credits could potentially be added to the incentives of an implementation program, with a legislative change. They can be effectively directed towards home owners, commercial building owners, or design professionals. Tax credits could be direct credits for energy-efficient buildings, or commercial building owners could be allowed to expense design fees associated with energy conservation rather than capitalize them. In either case, tax incentives would increase the demand for energy-efficient designs and/or buildings. Since economic incentive already exists to comply with the Standards (i.e., the Life Cycle Cost (LCC) of owning and space conditioning buildings has decreased), tax incentives may be viewed as an overinvestment by government.

Congress has used the Federal tax structure to provide incentives for actions deemed in the national interest. This is because the provision of incentives via this mechanism is not subject to the review and bargaining that is part of an annual appropriation process (Surrey 1973). Over the long term, then, tax incentives would have few impacts on Federal institutions. The Internal Revenue Service has considerable experience in developing the necessary forms and procedures for implementing such incentives efficiently, and the costs of administering the incentives through the tax system would be minimal. However, incentives would reduce tax revenues available to the Federal government, placing budgetory pressure on other programs.

Tax incentives, however, would be available only to those individuals who pay income taxes and would not benefit businesses that showed a loss in a given year. Further, if the incentives took the form of taxable deductions, as opposed to tax credits, they would be inequitable because they would benefit those in the highest tax brackets.

5.1.1.2.2 SANCTIONS

The Federal government can exercise three types of sanctions to encourage compliance with the Standards: 1) jawboning; 2) administrative sanctions, including the sanction in the Act; or 3) the imposition of civil, or criminal liability for non-compliance.

Impacts on Federal, state or local agencies and lending institutions are particularly important in two ways. First, new obligations imposed on an agency may conflict with other missions or obligations of the agency. This conflict can take the form of competing demands on scarce organizational resources of time, personnel, and budget, and it can take the form of contradictions among the objectives of different agency policies. Second, an agency may resist the implementation of a new policy that it perceives to conflict with the existing policies and programs, and that resistance may mean that the new policy is not implemented as designed, and does not work as intended. In short, one set of impacts consists of those felt by administering agencies themselves, and when those agencies react to those impacts, their actions in turn affect the effectiveness of the policy under consideration.

As noted above, Congress must first approve the use of sanctions. Assuming this has happened, exercising the sanctions will not be automatic--a Federal financial regulatory or building assistance agency may not be willing to block the provision of a loan by lending institutions or the provision of financial assistance to a project that might not fully comply with the Standards. The Federal Reserve System, for example, is directed by a Board of Governors that is independent from direct control by both Congress and the President. Other agencies are nominally subject to more direct control by the President, but nevertheless have as a matter of practice sufficient independence to resist the imposition of sanctions that they think unwise.

Whether an agency will be willing to apply the appropriate sanction will depend on the explicitness of the congressional mandate, its own perception of the importance of applying such a sanction, of the potential harm from doing so, of the political pressures on each side of the issue, of the attitude of the particular committees and Congressmen that have direct responsibility for oversight of its activities, and so forth. Three points can be made.

First, because of the uncertainty in the application of one sanction, it may be valuable to have redundant enforcement routes for given types of buildings or given jurisdictions. However, it is also useful to determine the proportion of buildings covered by multiple enforcement routes. The more buildings that are covered by multiple enforcement routes, the greater the likely effectiveness of the package of enforcement mechanisms.

A second point is that the willingness of an agency to impose a sanction may be inversely related to the scale of that sanction: heavy penalties imposed on broad numbers of buildings or jurisdictions may be less likely to be imposed than lighter penalties directed at smaller targets.

A final point is that the character of the regulatory activity engaged in by the enforcing agency may also influence its willingness to impose these sanctions. Specifically, an agency which currently uses a project-by-project or building-by-building approval process may find it relatively easy to add compliance with the Standards to the set of

criteria for aproval, while an agency that exerts no such specific approval process may be unwilling to initiate any such review. Some other HUD housing subsidy or building loan guarantee programs have similar approval processes. On the other hand, the Federal Reserve System or the Comptroller of the Currency or other financial regulatory agencies are not likely to have any existing routine approval process to which the Standards can be grafted. For that reason, these financial regulatory agencies would be more likely to resist being used as an enforcement mechanism for the Standards.

o Jawboning

Jawboning can be used to promote a program through the available communication (published and unpublished) system. Jawboning efforts, in and of themselves, though they may be costly to the Federal government, are not likely to induce significant compliance by state and local governments. Jawboning is likely to be most effective when widespread compliance with the Standards exists and when it is directed toward a limited number of recalcitrant jurisdictions.

o Administrative Sanctions

Federal administrative sanctions can take the form prescribed by the Act as well as alternative forms that would alter the number of assistance programs affected and/or the geographic scope of the sanction. One important aspect of the sanctions is that each requires Congressional action either to authorize or to require the Federal agency providing assistance to implement the sanction. Changing the sanction, either geographically or in terms of the number of assistance programs affected, is likely to be opposed in Congress.

Decreasing the number of Federal assistance programs from the number described in the Act would lessen the impacts at the Federal level and at the local level, specifically to lending institutions and the building industry. However, it might also decrease the level of compliance with the Standards.

Broadening the sanctions, either to cover a broader geographic area or to include additional assistance programs used for administering sanctions, is likely to be opposed strongly. State and local governments would oppose a broad geographic sanction, since it would penalize an entire state for the non-compliance of one jurisdiction. Opposition to broadening the scope of the sanctions to include more Federal assistance programs would probably be strong enough to make enactment of broad sanctions politically infeasible and could undermine support of the implementation program in Congress. Even if broad sanctions were approved by Congress, various Federal agencies, viewing the traditional goals of the assistance programs they administer as more important than implementation of the Standards, would be reluctant to implement the sanctions.

o Civil and Criminal Sanction

An alternative to the imposition of administrative sanctions would be imposition of civil, or criminal liability for non-compliance. This would require additional Federal government employees and enforcement would place additional demand on the Federal judicial system. However, this type of sanction might be viewed as more equitable than broad administrative sanctions, because only those who have either falsely or improperly determined plans to be in compliance or constructed a building to a plan that was not determined to be in compliance would be punished.

State and local governments, and organizations of design professionals and builders could be expected to oppose the imposition of civil or criminal liability for non-compliance. State and local governments are likely to want to avoid incurring any liability. Most would probably prefer to have liability rest with a design professional. Thus, this type of sanction would lead to states and localities adopting an AAP rather than a code-compliance process.

5.1.1.2.3 EXEMPTIONS

When a program is mandatory with the provision of a sanction for non-compliance, then the administering agency is required to provide an exemption. Section 305(a)(3) specifies that any new building "located in any area in which the construction of new buildings is not of a magnitude to warrant the costs of implementing final performance standards," then the area can be exempt. Section 305(a)(3) further states that a determination by the Secretary will be made after receiving a request for such determination. The request must be accompanied by materials justifying the request. Additionally, 305(a)(3) specifies that whenever the Secretary finds that the amount of construction of new buildings has increased to the extent that such costs for compliance are warranted, then the exemption can be rescinded.

Administering exemptions at the Federal level is only required under an action that is sanctioned. The impact includes requests for exemptions, supported by justifying materials, and investigations that must be undertaken in order to evaluate whether an area should remain exempt or be forced to comply because of increased new building construction. However, when a program is mandatory, exemptions must be available for those states or localities where the burden would be greater than the benefits to avoid unequitable impacts.

As the implementation program could vary depending on whether incentives were provided, and assuming sanctions, then the criteria for assessing whether costs for compliance are unwarranted would change. Thus, a program which provides no incentives for establishing a compliance path would have greater direct costs at the state and local

level. The variation in determination would be closely tied to the criteria established to measure costs, and how the level of new construction is determined. Establishment of criteria will undoubtedly be controversial as some states may try to avoid compliance via the exemption process.

The establishment of an exemption process that is applied to building designs or building type would probably be warranted. It would allow a design professional the opportunity to seek an exemption for a building design under certain criteria. This would alleviate many of the impacts of non-compliance where it is warranted. Additionally, there are several building types which have not been assigned an energy budget, but have been given space reserved. Thus, these buildings would be given an exemption until a budget has been assigned.

5.1.1.2.4 MONITORING

Federal monitoring may be conducted for two purposes: first, to monitor compliance with the Standards by state and local governments, design professionals and builders, and second, to monitor the actual energy consumption of buildings designed in compliance with the Standards to test the effectiveness of the Standards. Federal monitoring of compliance is likely to be politically unpopular. A Federal program to monitor actual energy consumption, although it would require considerable resources, would probably not be opposed, and might be supported by those interested in promoting knowledge of building energy conservation.

5.1.1.2.5. UPDATING

The impacts on Federal, state and local governments, and on the building industry are likely to increase when the Standards are updated. Many states have taken up to 3 years to implement existing building energy codes, even though few demands have been made on state administrative agencies and few changes in local code enforcement have been required. If the Standards were updated more often than every 5 years, the cost of the Standards program would be very high, and the confusion and resentment created could jeopardize the entire Standards program. On the other hand, as the price of energy rises, the Standards must be upated or they could become outdated. The costs of implementing new Standards should be balanced against the energy savings derived by doing so in any determination of how often the Standards could be updated.

5.1.1.3 TOOLS TO ENCOURAGE COMPLIANCE

A number of implementation tools, as defined in Chapter 3, could be provided to offset the impact of implementing the Standards. These tools, which include prequalification of existing codes, development of the SET and CET, and a manual of recommended practices are designed to help state and local governments and the building industry to evaluate existing codes and/or develop new standards or codes.

o Prequalified Codes

Some level of effort in prequalifying codes would seem to be an investment that repays itself over time. State and local government would not be forced to invest the time in developing new codes or in updating existing ones, and the Federal government would not have to spend a comparable amount of time in determining the equivalency of each of these codes.

Prequalification of a code based on the ASHRAE standards would do much to encourage code adoption, since the majority of existing state and local energy codes are based on national model codes, which, in turn, were based on the ASHRAE 90-75 standards. Prequalified codes based on HUD's MPS and the FmHA standards would be the next most successful, respectively. Prequalification based on other existing codes or standards is likely to have only marginal success in encouraging compliance, since these codes have limited influence.

For a number of reasons, a prequalification process that includes representatives of code officials, standards and code organizations, design professionals, and builders will have greater success in encouraging implementation than a process that excludes them. By including them the Federal government would demonstrate that it wanted to shape its policies to respond to the needs of those affected by them. The representatives could provide insights into the problems likely to result from a proposed action and could contribute to workable solutions for achieving the Federal objectives. Most important, the participation of representatives from a broad spectrum of interests could legitimize the prequalification process and encourage compliance with the Standards through state and local adoption and enforcement.

o Development of SET and CET

The techniques embodied in SET and CET are necessary for Standards implementation. The political feasibility of successfully implementing the Standards would be impaired without having these tools before implementation. If the Federal government does not assume the responsibility of developing these tools, the task will fall to the design professions, standards or model code organizations, and state and local code agencies. The Federal government will then have to evaluate a number of different energy codes and a multitude of building

designs with various existing computerized models of building energy consumption. Considerable time and effort will be required simply to understand the differences between the various computer models of building energy consumption. Developing procedures for achieving relatively uniform results in the evaluation of building designs and energy codes will require additional time. This is likely to delay implementation of the Standards.

Regardless of how and by whom the SET and CET programs are developed, their design will be expensive and time-consuming. Alternative computer models must be developed, then verified and accepted. The process may require administrative hearings and could provide further opportunities for legal challenges through the courts. The result may be further delay in implementing the program. Thus, the early development of SET and CET should be a priority of the implementation program.

o Manual of Recommended Practices

The development of a manual of recommended practice would provide guidance to design professionals, builders, and local enforcement officials in complying with the Standards. Since Manuals of Recommended Practice are standard in the building industry, the lack of one might be burdensome on those who presently utilize one to design or evaluate designs. The manual provides a short cut to information, whether it is information on requirements or available alternative solutions. The development of a manual which then could be adopted to specific state or localized needs would be cost-effective.

5.1.2 IMPACTS ON BUILDING INDUSTRY GROUPS

This section discusses the impacts of the Standards on building industry groups, on the design and construction professionals and material manufacturers, as well as on the associations that represent them. These impacts would depend on the training programs, incentives, and implementation tools used to implement the program. Because these groups are interrelated in the building process, many of the impacts that affect one group would affect others.

5.1.2.1 DESIGN PROFESSIONALS

Architects and engineers, the design professionals for the building industry, would support energy performance standards that enhanced their opportunities to use innovative design techniques. The performance option gives them the opportunity, but it is rarely

included in existing component-based codes. Existing codes require what is a costly design process. Designers must design the structure by packaging components, then redesign it to optimize energy use by changing components. Building a performance option into the codes would allow the designer to design the structure only once. It would require more design time initially, but as designers became familiar with the standards and how to calculate energy efficiency, it should prove cost-effective. Furthermore, since structures would increase in cost as a result of the Standards, designers, whose fees are based on a fixed percentage of the cost, would undoubtedly benefit.

Designers would need to increase their understanding of energy-conserving strategies, including design strategies, the integration of subsystems, and new and existing products and properties. Training programs for architects/engineers would then be needed in the implementation program.

If designers are liable under the Standards program, two results are possible. One, they will spend more time and take more care in developing their designs; two, they may refuse to design certain buildings without a substantial increase in fees.

Two liability issues are being examined: 1) whether a design professional can be held liable, and if so 2) whether to clear them from liability or to limit liability. Under the proposed action liability is limited. Designers are held responsible for determining that new building designs are in compliance with the Standards, but not for actual performance of the structure. The issue is then whether the designer would be liable for damages with a design which falls short of the Standards. Assuming the design professional may be held liable for negligent energy design, what third parties could also bring a cause of action for improper determination? If the determination is made by an independent architect/engineer, could they reasonably be expected to carry liability? If the design reviewer or a municipal employee provides the determination, would the owner, the contractor, the designer or a subsequent purchaser qualify as a third party? These issues will be addressed in the draft implementation regulation.

Designers are likely to support the AAP because it would integrate them into the building process. Design professionals in areas where no codes exist or in rapidly growing ones, could alleviate the burden on local governments. A potential problem, however, is that those areas with the highest growth rates also may have the least number of available architects and engineers, and an AAP would demand much of their time.

Designers would be most interested in those implementation tools that would ease the burden of developing designs to meet the Standards. The most critical implementation tools for designers are the SET and CET. The CET would enable code equivalency to the Standards to be evaluated. The SET can be used to determine the design energy consumption of the building, and therefore whether a design is in compliance with the Standards.

The major negative impacts to designers would occur during the initial adoption period. Buildings being designed at that time would have to be redesigned to meet the new code, a time-consuming and costly process. Confusion during initiation of the implementation process that delays approval of the code or of financing and delayed enforcement as code officials become familiar with checking for energy components and construction techniques could also cause problems for the design profession in terms of missed deadlines and cost overruns.

5.1.2.2 CONSTRUCTION PROFESSIONALS

Many of the impacts discussed under design professionals would also affect the construction profession. The cost of building new, energy efficient buildings may increase substantially for several reasons. First, builders would spend more time in interpreting design drawings. Second, builders and contractors would have to obtain designer approval to change a design or substitute a material or subsystem because the change might affect energy use. Third, if different codes existed for each jurisdiction, the additional time required for code compliance could increase construction costs. Finally, construction professions may require costly training on the requirements for compliance with the code and to sharpen or enhance construction skills if budget levels require significant changes in building practices. One way to alleviate these increased costs is through incentives to construction professionals. Just as for the designers, liability may be an issue for the construction professionals. Rather than risk liability, they may choose not to build certain buildings or to use standard building designs that have been approved.

5.1.2.3 MANUFACTURERS

There would be two major institutional impacts to material manufacturers as a result of the Standards. First, they may be required to demonstrate, either through test ratings and/or comparative testing by independent testers, the accuracy of material and subsystem specifications. The challenge would be to provide accurate information on each material and to develop accurate comparative information. Second, because they may be liable, manufacturers may take more time in developing specifications so that they could avoid challenges that a product does not comply with written specification. The quantitative changes to the manufacturers of building materials are discussed in TSD No. 7 and TSD No. 8 (DOE 1979a and DOE 1979c).

5.2 SOCIOECONOMIC IMPACTS

This section summarizes impacts of the Standards on the national economy and on regional economies as represented by selected BEA regions. At the national level, impacts are shown for each of the five hypothesized penetration paths described in Section 3.3. At the regional level, analysis was conducted to determine the change in employment and earnings resulting from the implementation of the Standards. This analysis was carried out for alternative penetration rates. In addition, the relationship between sanctions, incentives and regional impacts was identified.

5.2.1 NATIONAL ECONOMIC IMPACTS

The impacts on key macroeconomic indicators, selected industries and employment from implementing the Standards were determined for alternative penetration rates. The impacts by components of an implementation program were not identified. Impacts on the national economic parameters were summarized in Section 3.5.2. A detailed discussion of these impacts is found in Appendix C. The rest of this section summarizes impacts on consumers.

The impacts on consumers from implementing the Standards are divided into four categories: 1) increased building capital cost, 2) net present value of the Standards, 3) consumer response, and 4) equity implications. These impacts are discussed in more detail in Appendix C.

5.2.1.1 BUILDING CAPITAL COSTS

The impact of the standards on building capital cost is independent of the implementation program. The impacts are summarized in Section/3.5.2 and discussed in detail in Appendix C.

5.2.1.2 NET PRESENT VALUE OF THE STANDARDS TO CONSUMERS

The NPV of investments in energy-conserving improvements required by the Standards is also summarized in Section 3.5.2. Tax incentives to home buyers to purchase houses that comply with the Standards would increase the NPV of the investment to the consumer. This is discussed in detail in Appendix C.

5.2.1.3 CONSUMER RESPONSE

Consumer response to the Standards would affect property values (housing first cost) and housing starts. The methodology used to determine property value and housing start impacts is described in Appendix C. The impact on property values is considered first.

5.2.1.3.1 IMPACTS ON PROPERTY VALUES

The impact of the Standards on property values (housing first costs) was analyzed for a 100%, 60% and 20% penetration rate for each of the 5 penetration paths. A 100% penetration rate is considered first. Consumer willingness to pay for improvements in energy efficient housing was estimated. The results indicate that the increase in building capital cost that would result from the Standards is greater than average consumer willingness to pay for the improvement in housing energy efficiency that would result from the Standards. The analysis was based on 1976 data and, therefore, could underestimate consumer willingness to pay.

As a result of the Standards, the first cost of housing would be expected to increase, on average, approximately 2%. However, given that in the short run consumers are generally not willing to pay the full additional cost of the Standards, the price of houses that comply with the Standards would have to be slightly discounted in order to sell. It also seems reasonable to expect that prices of older houses not built to the Standards would be bid up slightly in value because of consumers' unwillingness to pay for the full additional cost of building a house to comply with the Standards.

In the long run, it would be expected that consumers would become aware of the full value of housing that complies with the Standards. After some consumers live in housing that complies with the Standards, information will circulate on the true value of a 30% increase in housing energy efficiency. Previous analysis, which is discussed in TSD No. 8, Economic Analysis, has shown that assuming a 3% real discount rate and a set of rising energy prices, the Standards would actually decrease the life-cycle cost of housing. Under this scenario, the first cost of new housing complying with the Standards would rise by the full 2% additional cost, and the price of older houses not built to the Standards may decrease slightly because of the relative increase in demand for housing that complies with the Standards.

With a 20% national penetration rate, many consumers would be able to choose from three types of housing: 1) older homes which may or may

not be energy-efficient, 2) new homes which comply, and 3) new homes which do not comply. If, in any particular locality, the number of type 2 houses built was a relatively low percentage of the total, then in the short run, property values for houses in compliance with the Standards would be expected to increase by the full 2% additional cost. Type 2 houses would not be discounted because, given the relatively small number of the houses, there would probably be enough consumers willing to pay the additional 2%.

In the long run, one would expect that information on the value of housing energy efficiency would circulate to consumers and the penetration of the Standards would increase as builders respond to consumer demand for improved housing energy efficiency. Property value impacts would then be described by the long run, 100% penetration rate scenario discussed above.

With 60% of new residential construction complying with the Standards, one would expect the effects to be somewhere between the 100% and 20% cases. The long-run impacts would not vary from the 100% penetration rate scenarios.

o Relationship Between Property Values and Incentives

The relationship between incentives and property values is considered next. Two incentives, tax credits and a public information program, are examined. A full tax credit (100%) is defined as a tax credit to consumers that would equal the increase in housing capital cost due to the Standards. A partial tax credit (50%) is defined as a tax credit that would equal half the increase in housing capital cost due to the Standards. An effective public information program is defined as one that educates consumers to impacts of the Standards on a buildings' life-cycle cost.

This discussion on tax credits assumes a 100% penetration rate. With full tax incentives the first cost of housing that complies with the Standards would be expected to increase by at least 2% in the short run. A temporary shortage of housing that complies with the Standards may cause first cost to increase by more than 2%. In the long run, the first cost of new housing would be expected to increase by 2%. With partial tax incentives housing that complies with the Standards might be slightly discounted in some localitites; and as with full tax incentives, first cost of new housing that complies to the Standards would increase by 2% in the long run.

With an effective public information program and no tax credits, the price of housing that complies with the Standards would increase by approximately 2% in both the short and long run. With both full tax credits and a public information program, property values of housing that complies with the Standards are expected to increase by more than 2% in the short run. In the long run property values would increase by approximately 2%.

o Impact of Sanctions on Property Values

The sanction presently written into the Act indicates that all federally controlled mortgage funds would be denied to a recalcitrant area or builder. This sanction would cause a substantial reduction in housing starts if invoked. Consumers' choices in housing would be narrowed to existing houses and new housing starts that can not be controlled by federally regulated agencies. Thus, the sanction would cause a relative increase in demand for the remaining housing whose property values would increase substantially. A quantitative estimate of the increase is not available at this time.

5.2.1.3.2 IMPACTS ON HOUSING STARTS[1]

The impact of the Standards on housing starts is analyzed for a 100%, 60% and 20% penetration rate. Assuming a 100% penetration rate and using results from the analysis of consumer willingness to pay for improvement in housing energy efficiency described above, it was determined that, in the short run, housing starts would decrease by at most 1.8% to 2.8%. In the long run, consumers are expected to be willing to pay for the full value of housing that complies with the Standards. Previous analysis, which is discussed in TSD No. 8, Economic Analysis (DOE 1979c), has shown that assuming a 3% real discount rate and a set of rising energy prices, the Standards would actually decrease the life-cycle costs of housing. Thus, in the long run, the perceived cost of housing would be lowered slightly under these assumptions, and housing starts would be expected to increase slightly.

Decreasing the penetration rate from 100% to 60% would cause a corresponding decrease in the amount of the short run negative impact on housing starts. With a 20% penetration rate, housing starts would not be expected to decrease in the short run. Lower penetration rates in the long run would lead to smaller positive impacts on housing starts than higher penetration rates.

o Impacts of Incentives on Housing Starts

Assuming a 100% penetration rate, full tax credits would cause a short run increase in housing starts of from 0 to 1.4% and a long-run increase of from 1.0% to 2.8%. With partial tax credits, short run housing starts would decrease by from 0 to 1.4%. Long run housing starts would increase by from 0 to 1.4%.

[1]The housing start impacts are based on the assumption that the first cost of housing that complies with the Standards increases by 2% as a result of the Standards. This approach provides an estimate of maximum negative impact.

With an effective public information program and no tax credits, housing starts would be expected to increase slightly in both the short run and long run. With both full tax credits and a public information program housing starts would increase by as much as 1.8% to 2.8% in both the short and long run.

o Impact of Sanctions on Housing Starts

Two types of sanctions are considered: (1) the sanction discussed in the Act that would cut off all federally regulated mortgage money to a recalcitrant area, and (2) a cut-off of state funds from the Standards program.

Section 3.3 of this document discusses the percent of commercial and residential building that uses federally regulated mortgage money. The percent of residential housing starts using federally regulated mortgage money is at least 66%. The percentage of commercial building controlled by this sanction was not calculated because of data deficiencies. Thus, if this sanction were invoked, it is assumed that at least 66% of residential construction and an unknown percentage of commercial building would be stopped in the recalcitrant area. (This, of course, assumes that nonfederally regulated mortgage sources do not loan more money after the sanction is invoked.)

The impact on housing starts of cutting off state funds under the Standards program would be minimal. It is possible that some state and local building may be halted, but that would represent a small percentage of construction. The reason for the small impact on housing starts is that state receipts from Federal agencies do not directly affect the consumers of residential and commercial buildings. The limitations of these results are described in detail in Appendix C.

5.2.1.4 EQUITY IMPACTS OF THE STANDARDS

The methodology used to derive the equity impacts is described in Appendix C.

Analysis exists which supports the hypothesis that lower income groups may not be willing to pay as much for the improvements in housing energy efficiency mandated by the Standards as higher income groups. If this is the case, any detrimental impacts of the Standards on property values or housing starts may be felt more dramatically among lower income groups than among higher income groups.

Secondly, analysis indicates that some consumers do consider building life-cycle costs, and are therefore likely to see no change or perhaps even a decrease in life-cycle costs due to the Standards. It is not clear, however, whether lending institutions would also see the decrease in life-cycle costs or whether they would continue to make mortgage decisions on the basis of first costs. If they continue existing

procedures, then individuals that fall on the borderline of credit worthiness (typically individuals in lower income groups) are likely to be priced out of the market. It has not yet been reasonably estimated how many people this may affect. However, the Federal government has taken steps to inform lenders about the need to consider energy expenses when mortgages are negotiated. If these steps are effective, then some of the equity impacts of the Standards can be mitigated.

The two equity impacts described above implicitly assumed a 100% penetration rate. How would tax incentives and lower penetration rates affect the equity impacts of the Standards? Generally speaking, tax credits can alleviate adverse equity impacts of the Standards. For instance, 100% tax credits will mitigate the cost differential, for almost all income groups, between houses that comply with the Standards and houses that do not.

Similarly, if the Standards penetrate 60% or 20% of new homes instead of 100%, lower income groups would again be insulated from adverse impacts. If housing that does not comply with the Standards were available at the same price as if the Standards were not implemented, then lower income groups would be no worse off.

5.2.2 REGIONAL ECONOMIC IMPACTS

Two key parameters of regional economic activity were examined to estimate the regional economic impacts of the Standards, local earnings and local employment. Bureau of Economic Analysis (BEA) areas were selected as the unit of analysis. The methodology used to derive impact estimates as well as a detailed discussion of regional impacts is described in Appendix C.

A sample of 11 BEA regions was selected for analysis. The 11 regions were selected to achieve wide diversity among a number of characteristics. The characteristics used to determine region selection were those hypothesized to be related to the magnitude and direction of the regional impact of the Standards. These characteristics include total population, population growth rate, regional energy prices, and per capita income. Two suggested characteristics were not available at the BEA region level: unemployment rate and share of minority population. Labor force participation rate and the non-white share of the labor force were used, respectively, as substitutes. The 11 regions selected and their characteristics in various years are shown in Table D-9 in Appendix D.

The impacts of the Standards on regional earnings and employment in the BEA regions are discussed in relation to sanctions and tax credits the government could adopt to facilitate the implementation and enforcement of the Standards. This analysis assumed that 100%, 60% or 20% of new building construction complies with the Standards. Further, it was

assumed that incentives could be granted such that 100% of any additional cost to the consumer due to the Standards is returned to the consumer (the additional housing first cost is estimated to be 2%).

With a 100% penetration rate and no incentives the impact of the Standards on earnings and employment was extremely small and greater than zero for all BEA regions examined. Reducing the penetration rate to 60% and 20% causes an even smaller positive impact. The introduction of full tax credits causes a very small increase in the positive impact on earnings and employment. Appendix C provides a complete description of these results.

5.3 PHYSICAL ENVIRONMENTAL IMPACTS

Impacts affecting man's physical environment may occur as a result of the implementation of the Standards. These impacts would relate to changes in consumption of energy and changes in release rates of pollutants, and would be secondary impacts insofar as they relate to the implementation alternatives. The primary impacts of implementation are the differences in the rates of implementation at the state and local level and differences in the application of the Standards to new construction. The impacts on man's physical environment are, in turn, driven by these differences in penetration rates and, thus, are considered to be secondary. This section discusses the way in which these impacts vary according to level of penetration.

5.3.1 METHODOLOGY TO DETERMINE IMPACTS ON THE PHYSICAL ENVIRONMENT

The methodology for estimating impacts on energy use has been discussed in detail in Chapter 7, TSD No. 8, Economic Analysis (DOE 1979c). The methodology for the calculation of the physical environmental impacts, i.e., changes in releases of pollutants, is described in detail in TSD No. 7, Draft Environmental Impact Statement (DOE 1979a). In brief, the procedure for estimating these impacts begins with a projection of the changes in use of various building materials associated with changes in building practices which may occur under the Standards, assuming complete penetration of the Standards. Changes in the releases of pollutants associated with the manufacture of these materials were calculated by multiplying the projected changes in demand by the appropriate residual coefficients. (Residual coefficients relate the quality of pollutant released per unit of production.) These changes in pollutant release were then adjusted for the projected schedule of penetration rates.

With the same schedule of penetration rates, the projected reductions in energy use occurring as a result of the Standards were calculated by fuel type. The reduction in pollutant releases associated with the reduced energy consumption was then calculated using an emission factor (quantity of pollutant emitted per unit of fuel consumed) or the appropriate residual coefficient for electricity generation, as appropriate.

The DEIS examined the impacts of the Standards under two scenarios, denoted Scenario A and Scenario B. These scenarios represented possible projections of penetrations of conservation codes in the baseline and with the Standards, future energy prices, dwelling characteristics, and coverage of the Standards. These scenarios were chosen to represent a "maximum impact" case and a "most probable" case.

Because the baselines differ for these two scenarios, a comparison of their impacts is inappropriate for assessing the impacts of implementation alternatives. Accordingly, five new scenarios representing different penetration schedules (designated Scenarios P-1 through P-5) have been developed, each of which represents the same fixed conditions (fuel prices, baseline conservation activities, and penetration of existing codes). The scenarios differ only in the schedule of penetration.

The current scenarios are derived from the Scenario B of the DEIS in that the same baseline, same levels of standards, and same fuel prices are used. Scenario B of the DEIS uses an implementation schedule which assures a quicker adoption of the Standards than Scenarios P-1 through P-5, a more complete penetration in the residential sector, and a smaller penetration in the commercial sector than the bounding scenarios used here. Scenario B represents a possible, although optimistic, schedule of implementation. Upon further analysis it was judged to not bound any of the implementation alternatives.

Scenario A as used in the DEIS is based on lower fuel prices than Scenario B or P-1 through P-5 and includes coverage of mobile homes. The penetration in Scenario A is somewhat slower in the early years than Scenario B or some of P-1 through P-5, but more complete in later years. Overall, Scenario A is judged to bound all scenarios by leading to the largest impacts.

5.3.2 ENERGY IMPACTS

Energy savings from implementing the Standards have been estimated for the five penetration rates developed in Section 3.3. Table 5.2 presents these estimates for 1985 and 1990 for each of the fuel types analyzed.

TABLE 5-2: Energy Savings (Quads)

Energy Type	PR-1		PR-2		PR-3		PR-4		PR-5	
	1985	1990	1985	1990	1985	1990	1985	1990	1985	1990
Electricity	.220	.455	.184	.390	.174	.364	.100	.206	.027	.049
Oil & Other	.050	.107	.040	.086	.030	.065	.021	.044	.005	.004
Natural Gas	.080	.158	.070	.140	.060	.133	.041	.092	.009	.017
Total	.350	.720	.294	.616	.264	.562	.262	.342	.041	.070

5.3.3 NATURAL ENVIRONMENTAL IMPACTS

Pollutant releases are projected to change as a result of implementation of the Standards because of increased manufacturing activities in industries making energy-conserving materials and because of reduced combustion of fuels for electricity generation and space-heating purposes. Detailed calculations and discussions of these impacts are given in the DEIS. In summary, it was found that, on a national scale, the Standards have a beneficial environmental impact. The reduction in pollutant releases associated with the reduction in energy consumption greatly outweighs pollutant release increases resulting from the manufacture of energy-conserving materials. These results were found to be insensitive to the stringency of the Standards.

It was also found that, relative to pollutant releases, the most significant changes occur for air pollutants. Accordingly, in order to compare the effects of different implementation strategies on the physical environment, only the changes in release of air pollutants are estimated. These are calculated for the five penetration scenarios using the same methodology as was used in the DEIS.

The results are summarized in Tables 5-3 and 5-4. Table 5-3 shows the changes in emissions of air pollutants, by pollutant and by scenario for the year 1990. Table 5-4 shows the change in emissions of sulfur dioxide and energy saving, by scenario, by year and cumulatively. The year 1990 was chosen as a representative year after the maximum negative physical impact of the Standards has occurred. Sulfur dioxide was chosen as a representative pollutant because the largest impact is projected for this pollutant.

Qualitatively, there are no differences in impacts between these scenarios. In each case, the overall result of implementing the Standards is beneficial. The greatest cumulative beneficial impact occurs for implementation Scenario P-1 because it represents the deepest and fastest penetration. Since the impact of the Standards is beneficial, the deeper the penetration, the greater the benefit. Thus, P-2 shows greater beneficial impacts than P-3 although the penetration scheduling for the two has the same initial value in 1982.

Scenario P-5 shows a slightly smaller reduction in carbon monoxide relative to the other scenarios than might be expected. This is because the residential sector shows a penetration greater than twice that of the nonresidential sector in this scenario. In the worst-case assumption of strategies used to meet the Standards as used for calculations in the DEIS, the projected increase in softwood lumber and resulting increases in emissions of carbon monoxide dominate. The size of this difference may be an artifact of the model and represents the type of uncertainty always present in such analyses. Nevertheless, the results present an accurate representation of the differences between the various penetration scenarios.

In all, examination of the natural environmental impacts shows no major differences among scenarios. The Standards, under each penetration scenario, are seen to be beneficial to the natural environment with only small quantitative differences among scenarios.

The preceding analysis addresses impacts as national aggregates. The DEIS noted that if the impacts were analyzed on a regional basis, certain negative impacts (associated with increase in manufacture of energy-conserving materials) might not be offset by corresponding reductions due to energy savings. The available information is insufficient to perform a detailed analysis of regional impacts; however, it is possible to make some informed estimates of the localities for which these may occur.

The industrial sectors projected to be most affected by the Standards are the flat glass, insulation and softwood lumber industries. As can be seen from Figures 5-1 and 5-2, the flat glass and glass fiber insulation industries are quite localized, due in part to a need to be near supplies of raw material. It is reasonable to suppose that, in the absence of other factors, production of these materials would increase in these same regions. Thus, it is possible that these regions may bear the full negative impact associated with production increases. Alternatively, the entire production increases may occur at new facilities located in regions other than those shown in Figures 5-1 and 5-2. In that case, the impacts of increased production would occur in these other regions. Chemical foam manufacturing facilities are geographically dispersed and it is probable that expansion for this product will be scaled to regional demand.

The production of softwood lumber is also regionalized as noted in Figure 5-3. This regionalization is associated with the location of the raw materials, i.e., forests. It is reasonable to hypothesize that

TABLE 5-3: ESTIMATED NET REDUCTIONS IN EMISSIONS DUE TO THE STANDARDS BY POLLUTANT AND BY SCENARIO[a] FOR THE YEAR 1990 (in thousands of tons)

Penetration Scenario[a]	Pollutant				
	Particulates	Sulfur Oxides	Carbon Monoxide	Nitrogen Oxides	Hydrocarbons
P_1	18	210	9.2	130	2.7
P_2	15	180	7.9	110	2.3
P_3	14	160	7.0	98	2.0
P_4	8.3	98	4.3	60	1.2
P_5	1.8	20	.91	13	.26

[a] Scenarios are described in text.

TABLE 5-4: ESTIMATED NET REDUCTIONS IN EMISSIONS OF SULFUR OXIDES DUE TO THE STANDARDS BY YEAR AND CUMULATIVELY AND BY SCENARIO

Penetration Scenario[a]	Yearly			Cumulatively		
	1985	1990	2000	1980-1985	1980-1990	1980-2000
P_1	100	210	390	250	1100	5900
P_2	87	180	340	200	920	5100
P_3	78	160	300	190	820	4600
P_4	48	98	210	120	510	3000
P_5	12	20	30	30	120	510

[a] Scenarios are described in text.

expansions in production of forest products will be proportional to existing production. If so, the impacts of increased production will occur in those regions shown in Figure 5-3 and in proportion to present levels of production.

This qualitative discussion of potential regional impacts does not provide a comparative basis for distinguishing among implementation alternatives. To the extent that the increases in production of energy-conserving materials result in localized negative impacts, the greater the penetration of the Standards (on a national scale), the greater are the regional impacts.

Potential impacts on building aesthetics, comfort and safety are discussed in detail in the DEIS. As discussed there, the Standards, because they are performance standards, need not result in negative aesthetic impacts. Impacts on comfort and safety, as described in the DEIS, are generally associated with misapplication of conservation strategies (e.g., natural illumination, insulation, reduced ventilation) or unusual conditions (e.g., fire). To the extent that such misapplication or such unusual conditions occur, the related impacts will occur.

The issue of air quality as a determinant of building comfort and safety was discussed in the DEIS. Because of this potential problem, the Standards, as set forth in the NOPR, include provisions designed to prevent reductions in indoor air quality. The impacts of implementation of the Standards on the indoor environment are dependent on the extent of misapplication of conservation strategies. In the absence of other factors, this will be scaled to the penetration rate. Likewise, the extent to which conservation strategies (used to meet the Standards) are subject to the unusual conditions is also scaled to the penetration rate. Thus, in the absence of other factors, impacts on the indoor building environment will be directly related to the penetration rate.

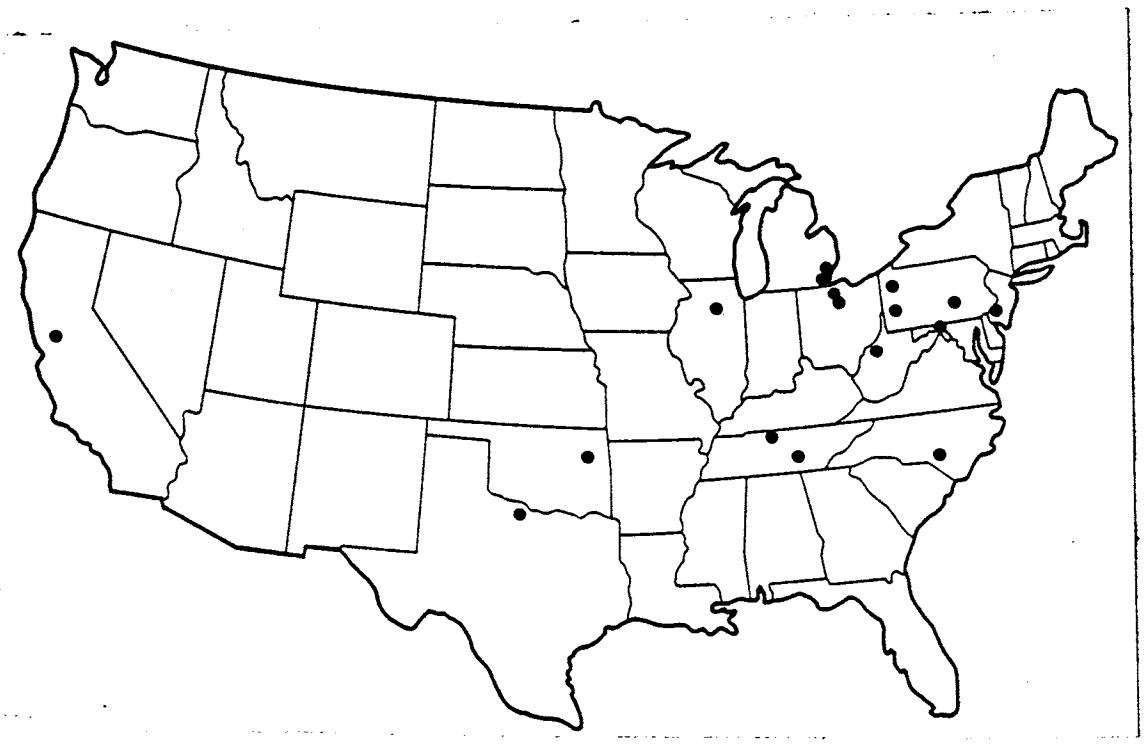

FIGURE 5-1: FLAT GLASS MANUFACTURING PLANTS

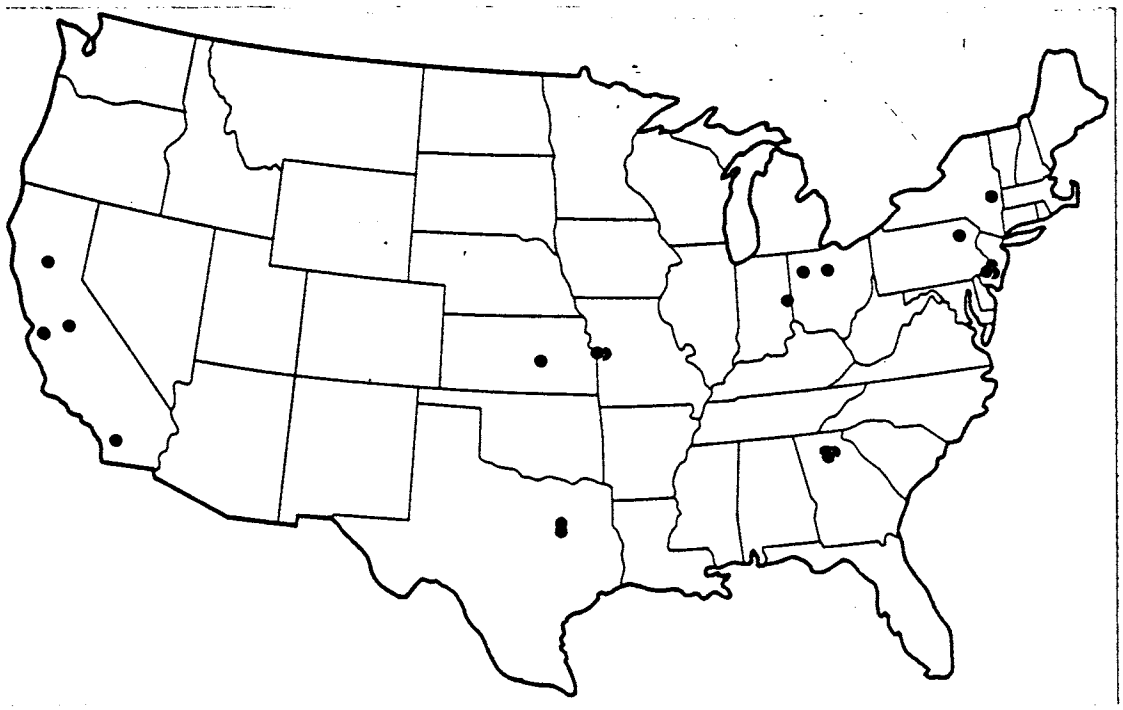

FIGURE 5-2: FIBERGLASS INSULATION

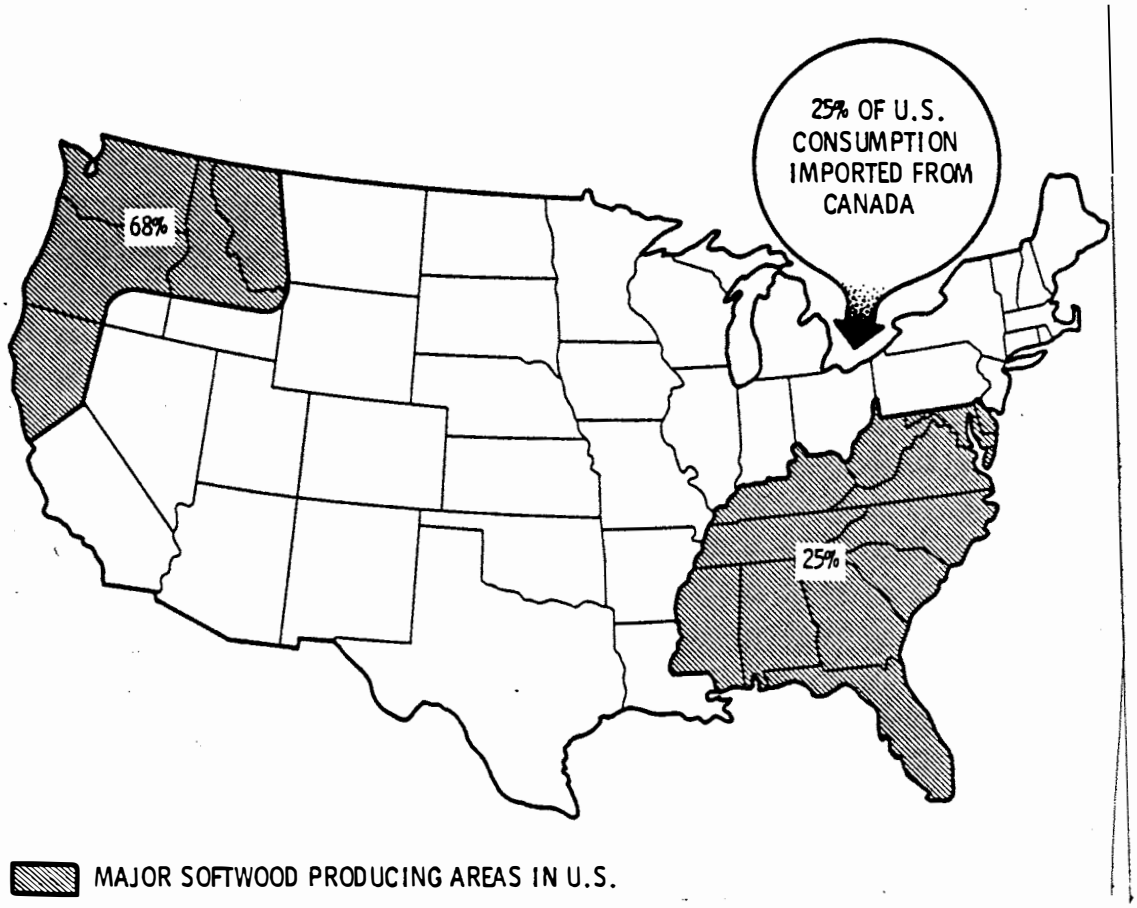

FIGURE 5-3: SOFTWOOD LUMBER PRODUCING AREAS

6.0 UNAVOIDABLE ADVERSE IMPACTS

This chapter discusses any probable adverse environmental (human and natural) effects which cannot be avoided under the proposed action. Many of these unavoidable adverse impacts are offset by benefits resulting from the overall investment in implementing the Standards. These tradeoffs are discussed in Chapter 7.

6.1 INCREASED BUILDING COSTS

The first costs of commercial and residential buildings may increase by approximately 1 to 2%. If energy conservation were considered during the initial design state, appropriate conservation methods could be included in the design, possibly resulting in only a small increase in first cost.

6.2 COMMITMENT OF CAPITAL AND OTHER RESOURCES TO MANUFACTURE ENERGY-CONSERVING MATERIALS

The construction of new buildings that meet the goals of the Standards may require an increased commitment of financial or other resources. The commitment of these resources would involve an opportunity cost. That is, these resources could otherwise be used to produce other goods and services. Thus, the use of these resources to manufacture energy-conserving materials involves an unavoidable adverse impact. (For more information, see section 5.2.)

6.3 COMMITMENT OF CAPITAL AND HUMAN RESOURCES TO IMPLEMENT AND ADMINISTER THE STANDARDS

Implementation of the Standards would involve an investment of human and institutional resources. These resources would be unavoidably committed in order to implement the Standards. Commitment of these resources also involves an opportunity cost. (For more information, see section 5.1.)

6.4 POTENTIAL SHIFTS IN SOME SECTORS OF THE CONSTRUCTION LABOR FORCE

Several trade groups may be unavoidably adversely affected. The degree of the impact is difficult to assess accurately, but is believed to be minor. The rate of growth for these trade groups may be altered. However, those employed will probably be able to shift to new positions or types of work of a similar nature which will increase. Shifts may also occur between regional areas. This shift is already evident but may be amplified by the Standards. Areas of high construction will continue to be areas of high construction. (For more information, see section 5.2.)

6.5 INCREASES IN POLLUTANT RELEASES FROM SOME INDUSTRIAL SECTORS

The projected shifts in demand for building materials, which vary by penetration rate, would result in some increased releases of air and water pollutants. These impacts would be unavoidable in order to obtain energy-conserving materials. (For more information, see section 5.3.)

6.6 COSTS OF THE STANDARDS MAY BE PERCEIVED TO EXCEED BENEFITS FOR LOWER INCOME FAMILIES

Recent research indicates that time preference for income, as measured by consumer discount rate, varies inversely with income. This suggests that the required payback period (in order for benefits to exceed cost) for lower income families is shorter than the required payback period for higher income families. The required payback period for some families may be less than the payback period associated with the Standards. Thus, some low-income families may perceive that the cost of the Standards outweighs the benefits. A quantitative estimate of the number of families for which costs will exceed benefits is not available. (For more information, see section 5.2.)

6.7 RESIDENTIAL HOUSING STARTS MAY DECREASE SLIGHTLY IN THE SHORT RUN

Analysis based on 1976 data indicates that the Standards may cause a slight reduction in housing starts in the short run. It is hypothesized

that recent energy price increases have significantly reduced the probability of any housing start decline as a result of the Standards. (For more information, see section 5.2.)

7.0 SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

This chapter analyzes the relationship between short-term uses of resources and the maintenance and enhancement of long-term productivity which may result from implementation of the Standards. Most of the short-term impacts are offset by energy savings and associated reductions in pollutant releases. For these reasons, the short-term and long-term impacts are presented as a tradeoff analysis.

7.1 INCREASED BUILDING FIRST COST COMPARED TO REDUCED ENERGY COST

The capital investment by the initial owner will result in a substantial energy savings and a positive NPV (an accounting term for describing the effective value of an action based on the financial rewards of that action). For example, commercial building first costs are estimated to increase by approximately 1% (or $0.38/sq. ft.). Annual energy consumption is projected to be reduced an average of 40%, resulting in an average NPV for a 20-year building life of $1.32/sq. ft. For single-family residences, the first costs are projected to increase approximately $1194 for an electrically heated home in Washington, D.C. This would result in an average annual energy reduction of 15%, which results in an average NPV of $1584. (See Section 5.2 for more discussion.)

7.2 CHANGES IN LABOR SKILLS COMPARED TO INCREASES IN TOTAL CONSTRUCTION LABOR

Certain construction trade groups may be affected by a decrease in demand for their services. But overall, the Standards could have a positive effect on the total construction labor force. Although some trades (such as electricians, masonry and stone setters, and roofing and siding installers) may be in smaller demand, increased opportunities in related jobs (such as installing electronic HVAC controls) are projected. Other construction trades may also experience increased activity. (For more information, see Section 5.2.)

7.3 INCREASED POLLUTION DUE TO GROWTH IN ENERGY CONSERVATION INDUSTRIES COMPARED TO DECREASED OVERALL POLLUTION DUE TO ENERGY CONSERVATION

Industrial pollution in certain industries may increase because of the increased demand for energy-conserving materials. However, this would

be quickly offset by reduction in pollution due to lower overall energy consumption. (A more detailed discussion is given in Section 5.3.)

7.4 INCREASED INITIAL RESOURCE COMMITMENT COMPARED TO LONG-TERM ENERGY SAVINGS

The initial increased short-term commitment of energy and resources to produce the energy-conserving materials and implement the Standards would be offset by the overall energy savings. The resources invested in producing the energy-conserving materials and implementing the Standards is compared to the energy saved from building operation (discussed in Chapter 5). This analysis shows that an initial increase in the commitment of resources will result in significant energy savings.

7.5 REDUCED RESIDENTIAL HOUSING STARTS COMPARED TO INCREASED CONSUMER INFORMATION

The Standards could cause a slight reduction in residential housing starts in the short run. However, in the long run it is expected that information on the actual value of the Standards will circulate to consumers. This information would come, in part, from consumers of housing that complies with the Standards. Thus, in the long run, it is expected that housing starts would increase slightly because the Standards will, on average, cause a slight decrease in housing life-cycle costs. (For more information see Section 5.2.)

8.0 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

This chapter discusses the irreversible and irretrievable commitments of resources which may occur as a result of the Standards. The chapter discusses the commitment of resouces, including natural and human resources, which are related to the adverse impacts and which will be irretrievable for the foreseeable future. The analysis indicates that there are irretrievable commitments of resources. However, the commitment of these resources for energy conservation has been shown to be a worthwhile investment.

8.1 RESOURCES USED FOR BUILDING CONSTRUCTION

The Standards will require the use of additional resources in the building construction process. The additional resources used would include human, natural, and energy resources. Human resources would be used in producing materials and constructing buildings. In addition, some retraining of contractors, construction workers and design professionals may be required. Natural resources used would include lumber, petroleum, silica sand and other ingredients used in the manufacture of flat glass and glass fiber insulation, limestone, clays and gypsum used in the production of Portland cement. Also energy resources would be used to produce the additional building materials. All the additional resources used in the building construction process would be irretrievable but not necessarily nonrenewable. (For more information, see Chapter 5.)

8.2 COMMITMENT OF HUMAN AND INSTITUTIONAL RESOURCES

A time and financial investment of both human and institutional resources would be irretrievably committed. The commitment of human and institutional resources would be made for implementation of the Standards. The resources that have been used, and are presently being used, to develop and promulgate the Standards and the implementation regulations are irretrievable. Additionally, resources at the Federal, state, and local level would be irretrievably committed upon promulgation of the Standards and of the implementation regulations.

GLOSSARY OF TERMS

Affidavit - a statement whereon the builder affirms that he will build according to an approved design which has been determined to be in compliance.

Alternate Approval Process - a method of compliance which requires a local enforcement official or a design professional to determine whether the design complies and an affidavit from the builder that the structure will be built to that design. The enforcement agency would receive and file the determination and affidavit in order to make a declaration that the building is designed and built to meet or exceed the Standards. The declaration would be used, by a person seeking construction funds, to signify to lending institutions that financial assistance can be given. The declaration is then collected and filed at the lending institution.

Area - a state or local unit of general purpose government where the Standards would be administered and enforced by a state or local official.

Ashrae 90-75R - building standards that were developed with energy sections by the American Society for Heating, Refrigerator, and Airconditioning Engineers. The energy section of the Standards are considered to be component-based with a section that provides a performance option.

Baseline - a base for measurement or comparison; as used here, refers to the environment which would occur in the absence of the proposed action. A baseline is not considered to be stagnant, but has projected changes that would occur in the future.

Building code - a legal instrument which is in effect in a state or unit of general purpose local government, the provisions of which must be adhered to if a building is considered to be in conformance with law and suitable for occupancy and use. When a building design is determined to meet or exceed building code's requirements, then a building permit is issued.

Building energy code - a legal instrument that specifies required energy efficient materials, subsystems, and systems.

Building energy performance code - sets energy level consumption goals for the entire structure and does not constrain or specify the materials, subsystems or arrangements within the structure.

Building permit - a certificate visibly displayed during construction that signifies the structure is designed to comply to the local building code and meets all local zoning requirements.

Certification Process - a method of compliance which requires that states submit to the administering agency a statement that the state or local jurisdictions within their state have adopted and are enforcing a building energy code that is equivalent to the Standards. Such building energy code must contain a performance option.

Code Equivalency Technique (CET) - a method which uses SET to evaluate Design Energy Consumption (DEC) of predetermined prototype buildings built under candidate state or local code. If the DEC of those prototype buildings is less than or equal to the Design Energy Budget allowed by the Standards the candidate code shall be judged to be equivalent to the Standards.

Component performance code - a legal building requirement which sets standards for specific parts of a building but does not specify the materials to meet those goals (e.g. R-19 walls regardless of what insulation is used to achieve it.)

Construction control mechanism - a legal instrument other than a building code to regulate building construction.

Design Energy Budget - maximum allowable weighted design energy consumption for a building design in reference to the expressed BTU/sq. ft/year.

Design Energy Consumption - the computer calculated energy consumption for building design, expressed as BTU/sq.ft./year, excluding process energy requirements.

Declaration - an issuance by a local jurisdiction that a determination and an affidavit have been received and are on file. The declaration issued, by a person seeking financing to show the lending institution that all requirements to meet the Standards have been.

Design compliance - a building design has been reviewed by an appropriate local enforcement official or a design professional for its design energy consumption and it does not exceed the energy budget set by the standard for that building classification.

Determination - a statement made by a local enforcement official or a design professional that a building design meets or exceeds the requirement of the standards.

Direct or Primary Impacts - the initial change in final demand for the socioeconomic sector, in impacts for the physical environment and in impact on institutions.

DOE-II - a computer program used to calculate the design energy requirements of non-solar single-family residential buildings and commercial buildings with central HVAC systems. It is also used to calculate building loads for processing by the TRNSYS program.

Energy budget level - the energy goals, in BTU/sq.ft./year, given in the Standards in terms of classifications of buildings and climate, and weighted by fuel type.

Equivalency - used to describe the status of an energy code that is at least as stringent as the Standards.

Exception - a process by which a design or building becomes exempt from complying with the Standards.

Exemption - a vehicle by which an area is released from imposition of the sanction because they do not have the manitude of construction sufficient to warrant the cost of implementing the standards. A state may grant the exemption after providing the secretary with justifying materials.

EXPLOR MULTITRADE - a national econometric input-output model which uses a traditional national input-output accounting framework to establish economic forecasts and to analyze the impacts of implementing the Standards.

General purpose local government - any city, county, town, municipality or other political subdivision of a state (or any combination thereof), which has a building code or similar authority over a particular geographic area.

Implementation program - a definite plan or procedure to ensure the administration and enforcement of the standards.

Implementation tools - devices or methodologies developed to assist in implementing the Standards and in complying with the Act.

Incentive - an administrative action to encourage compliance.

Indirect Impact - the changes that result from the intitial changes to buildings and energy savings.

Jurisdiction - the limit or territory within which authority may be exercised.

Life-Cycle Costing - methodology to calculate the total costs of providing a service to a building over its projected life time.

Manual of Recommended Practices - a handbook containing prescribed methodologies that would reduce the impacts on designers and constuctors by providing building plans and component systems which have been approved as being in compliance with the standards.

MCEC - refers to model code for energy conservation funded by DOE and developed by NCS/BCS.

Minimum Property Standards - standards enacted in 1974 by FHA to promote the use of energy saving techniques for newly constructed residential housing subject to federally subsidized or insured mortgages.

Net Present Value - an accounting term for describing the effective value of an action bond on financial rewards of that action; the present value of the expected return stream (U_o) minus the price (C_o), $U_o - C_o$, is called the net present value.

Penetration Rates - the rate at which compliance with the standards has been projected.

Performance Code - refer to building performance code

Performance standards - goal or goals to be met without specification of the method, materials, and processes to be employed in achieving that goal or goals but including statements of the requirements, criteria and evaluation methods to be used and any necessary commentary.

Prescriptive standard - a standard that contains goals, but also contains specifications of the methods, materials and processes to be employed in achieving these goals.

Promulgate - to make known (a degree, law, or doctrine) by public declaration, announce officially, to put (a law) into effect by formal public announcement.

Qualification - the process by which other energy codes are deemed to be equivalent to the Standards.

Sanctions - an action taken by the Federal government wherein federal financial assistance for constuction of any new commercial and/or residential building in any area of any state can be witheld.

(SET) Standard Evaluation Technique - an implementation tool that can be utilized by designers and builders to evaluate the energy consumption of a building via one of the computer programs (DOE-2). It is a computerized model for determining building compliance with the standards.

Standard - a degree or level of requirement, excellence or attainment (see performance standards and prescriptive standards).

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APPENDIX A PENETRATION RATES

The purpose of this appendix is to describe the calculations undertaken to derive penetration rates for the Standards, and to explain two methods for calculating resulting penetration rates.

Sections A.1 through A.4 deal with estimates of building mortgage funds that can be federally controlled through primary mortgages let by regulated financial institutions (A.1), construction loans (A.2), loan insurance programs (A.3), and Federal government secondary market purchases (A.4). All of these estimates are for coverge of new residential buildings, computed as percent of total new residential building value affected by a given institution. Commercial buildings are omitted because of lack of appropriate data. Section A.5 deals with the estimation of the percent of building in areas with either state or local energy codes. Section A.6 deals with the estimation of penetration rates. Each section first presents the methodology used and any qualifications or critical assumptions involved, and then presents the resulting estimates.

A.1 PRIMARY MORTGAGE LOANS LET BY FEDERALLY REGULATED FINANCIAL INSTITUTIONS

Several Federal agencies regulate financial institutions which originate long term mortgage loans for new buildings. Commercial banks are regulated by the Federal Reserve System (if they are members), the Federal Deposit Insurance Corporation (if they insure their deposits), and the Comptroller of the Currency. Savings and loans institutions insure their deposits through the Federal Savings and Loan Insurance Corporation (FSLIC). Federally chartered credit unions fall under the regulatory authority of the National Credit Union Administration. Some banks are not members of the Federal Reserve System. Some savings and loans may not insure their deposits through FSLIC. For the discussion that follows, we use the available data on all banks, savings and loans, etc. because of the paucity of data on coverage by the regulatory agencies. Hence, we overstate somewhat the potential control of the Federal government with respect to these institutions. The legal authorities and other characteristics of these Federal agencies are discussed above in 4.1.2.1.

A.1.1 METHODOLOGY

Two pieces of data are available to estimate the percent of new residential buildings covered by primary mortgages let by federally regu-

lated financial institutions. These are the value of new residential building mortgages originated by lender in a representative year, and the value of construction put in place in that year. These two pieces of data are not comparable. Mortgage loans are made on total property value, not just on building value. The construction data do not include land values. Thus, each piece of data has to be adjusted to the comparable basis of total property value.

The mortgage data are adjusted by multiplying the mortgage value (M) by the ratio of total property value to mortgage value (D). To estimate D, we took the average percent down payment on first mortgages in 1976 (DP) and computed (1/(1-DP)). The product of mortgage value and the ratio of total property value to mortgage value (V_M) is an estimate of the total new residential property value which was mortgage financed. V_M was calculated separately for federally regulated primary mortgage lenders (V_{MR}) (i.e., total new residential property value financed through federally regulated primary mortgage lenders was estimated). The value of construction put in place (C) is adjusted by multiplying C by an estimate of the ratio of total property value to building value (P). An estimate of residential land value (L) was derived from data on FHA mortgage loans. No other estimate of land value was found. The desired correction factor P equals (L + C)/C. While this estimate is probably biased, we do not know the direction or magnitude of the bias. The product of construction put in place (C), and the ratio of total property value to building value (P) equals V_C, the estimated total property value for all new residential buildings.

Finally, the estimate of the percentage of new residential building value covered by regulated financial institutions (V_R), (i.e., commercial banks, savings and loans, mutual savings banks, and Federal credit agencies) is calculated by the formula:

$$V_R = V_{MR} / V_C \qquad (A.1)$$

Nonregulated financial institutions include life insurance and mortgage companies.

Commercial building coverage by federally regulated financial institutions cannot be estimated because of data deficiencies. The mortgage data, shown in Table A-1, do not report new building data separately from all commercial buildings, which include renovations and repairs as well. No other source of appropriate mortgage data was found. The construction value data shown in Table A-2 do not separate commercial buildings from other nonresidential buildings such as industrial and farm buildings. Since the Standards do not apply to these other building types, the nonresidential construction value cannot be appropriately used. Also, no data were found on average down payments or on average land values for commercial properties.

TABLE A-1: LONG TERM MORTGAGE LOANS ORIGINATED IN 1976 BY TYPE OF LENDER (U.S. DEPARTMENT OF COMMERCE 1978c) (Billions of Dollars)

	Regulated Institutions				Nonregulated Institutions	
Property Type	Savings and Loans	Commercial Banks	Federal Credit Agencies	Mutual Savings Banks	Mortgage Cos.	Insurance Cos.
New Residential Buildings	18.9	6.3	2.5	1.7	5.4	0.5
All Residential Buildings	67.0	24.2	3.8	7.8	16.1	1.2
All Buildings (Residential and Non residential)	72.6	36.9	9.1	9.5	17.1	8.6

TABLE A-2: BUILDING CONSTRUCTION VALUE PUT IN PLACE IN 1976 (U.S. Department of Commerce 1978d)

Item	Value (Billions of $ 1976)
Residential	
New residential units	47.277
All Residential	60.520
Private Nonresidential	
Industrial	7.183
Commercial	12.756
Religious	0.956
Educational	0.660
Hospital, Institutional	3.396
Other	1.140
All Private Nonresidential	26.091
Public Buildings	
Federal Buildings	1.955
State/Local Government Buildings	11.526
All Public Buildings	13.471

A.1.2 RESULTS

Table A-1 shows the data on mortgage value by type of lender. New residential mortgage value (M) is taken from this table. Down payments on first mortgages average 24.7% in 1976 (U.S. Department of Commerce 1978a). Therefore the ratio of total property value to mortgage value (D) equals (1/(1-0.247)) = 1.328. The new residential mortgage values in Table A-1 were then multiplied by 1.328 to get total property value mortgage financed by federally regulated primary lenders (V_{MR}) equals $39.04 billion. Recall mortgage companies and insurance companies are nonregulated financial institutions.

Table A-2 shows the value of construction put in place for 1976. New residential building value (c) equals $47.277 billion. The land value estimate (L) is 20% of the total residential property value (U.S. Department of Commerce 1978b).

The ratio of total property value to building value (P) equals (0.2+ 0.8)/0.8 = 1.25, and the estimated total property value for all new residential buildings (V_C) equals 59.1 Therefore, the final residential coverage estimate, V_R, equals 39.04/59.1 or 0.66.

A.2 CONSTRUCTION LOANS

Construction loans are made to builders by the types of lenders listed in Table A-1. The available data on construction loans do not distinguish new buildings from existing buildings, nor do they separate commercial from other nonresidential buildings. Also, no data are available on builder down-payments or builder value added. Using assumptions to overcome these data deficiencies, the percent of total residential building value using construction loans from federally regulated institutions (V_{CL}) was estimated.

A.2.1 METHODOLOGY

Two estimates are required; first, the percent of total residential building value using construction loans, and second, the percent of construction loans provided by federally regulated institutions.

Builder value added for residential construction was assumed to be 25%. Down payment for construction loans was assumed to be zero. The level of construction loans in 1976 was increased by 25% and divided by the value of residential construction put in place in 1976 to estimate percent of total residential building value using construction loans.

The percent of construction loans provided by federally regulated institutions multiplied by the percent of total residential building value using construction loans would provide an estimate of the portion of total residential building value using construction loans from federally regulated institutions (V_{CL}).

A.2.2 RESULTS

The estimated value of new residential building using construction loans is $32.0 billion in 1976 (U.S. Department of Commerce 1978e). The value of residential construction put in place in 1976 was $47.3 billion (see Table A-2). Thus, the estimated percent of building value using construction loans is 68%. The percent of construction loans provided by savings and loan associations, commercial banks, and mutual saving banks in 1976 was 89% (U.S. Department of Commerce 1978e). Thus, an estimate of the percent of total residential building value using construction loans from federally regulated agencies (V_{CL}) equals 61%.

A.3 FEDERAL LOANS AND LOAN INSURANCE

The Federal Housing Administration (FHA) and the Veterans Adminstration (VA) guarantee loans made by financial institutions to homeowners. The Farmer's Home Administration (FmHA) makes loans to qualified home buyers for specified types of new residential buildings. Estimates of institutional coverage by FHA, VA and FmHA are developed and presented below.

A.3.1 METHODOLOGY

Data are available on the percent of new residential building units with mortgages guaranteed by FHA, VA, or FmHA. Data are also available on the value of construction financed and the number of units financed by FHA, VA, FmHA and conventional sources. The following formulas are used to calculate the percentage of new residential building value with mortgages guaranteed by FHA, VA, and FmHA (V_I):

$$\frac{N_{CV} \cdot \overline{P}_{CV} + N_{FVF} \cdot \overline{P}_{FVF}}{N_{CV} + N_{FVF}} = \overline{P} \qquad \text{(A.2)}$$

where N_{CV} = number of residential units using conventional financing

N_{FVF} = number of residential units using FHA, VA, or FmHA financing

$\bar{P}_{CV}$ = mean price of residential units using conventional financing

$\bar{P}_{FVF}$ = mean price of residential units using FHA, VA, or FmHA financing

$\bar{P}$ = mean price of residential units using either conventional, FHA, VA, or FmHA financing

$$\frac{\bar{P}_{FVF}}{\bar{P}} = R \qquad \text{(A.3)}$$

and

$$(\%FHA + \%VA + \%FmHA) \cdot R = V_I \qquad \text{(A.4)}$$

where %FHA = percent of new residential units being financed by FHA

%VA = percent of new residential units being financed by VA

%FmHA = percent of new residential units being financed by FmHA.

V_I = percent of new residential building value with mortgages guaranteed by FHA, VA, or FmHA.

A.3.2 RESULTS

Table A-3 shows the percent of new residential units financed by mortgage type. Table A-4 shows the dollar value profile of new residential units by financing mechanism. Using these tables and Equation A.2 $\bar{P}$, the mean price of residential units using mortgage financing, was calculated to be $47,794. The ratio of the price of housing using FHA, VA, or FmHA financing to $\bar{P}$, (R) is therefore equal to 0.78. Thus V_I, the percentage of new building value with mortgages guaranteed by FHA, VA, and FmHA, equals 19% times 0.78 or approximately 15%.[1] Table A-5

TABLE A-3: FINANCING CHARACTERISTICS OF NEW HOUSES, 1976 (U.S. Department of Commerce 1978f)

Mortgage Type	% of New Homes by Source of Funds
FHA Insured	6
VA Guaranteed	8
Conventional	67
Farmers Home Administration	5
Total	85

TABLE A-4: DOLLAR VALUE PROFILE OF NEW RESIDENTIAL CONSTRUCTION BY FINANCING MECHANISM, 1976 (U.S. Dept. of Commerce 1978g)

Value of New Construction	Source of Funds: Conventional (No. of Houses)	Source of Funds: FHA/VA (No. of Houses)
$30,000	22	31
$30-35,000	38	27
$35-40,000	66	30
$40-$59,000	128	34
$50-60,000	87	9
$60-75,000	70	3
$75,000	47	No estimate
Sample Size	458	134
Average Value	$50,850	$37,350

TABLE A-5: VALUE OF MORTGAGE INSURED BY FHA AND VA ORIGINATED IN 1976 BY LENDER (U.S. Department of Housing and Urban Development 1977)

	Billions of Dollars					
Mortgage Insurer	Savings and Loans	Commercial Banks	Mortgage Cos.	Insurance Cos.	Mutual savings Banks	Total
FHA	0.147	0.182	1.600	0.015	0.009	1.953
VA	0.462	0.181	2.319	0.012	0.025	2.999
FHA + VA	0.609	0.363	3.919	0.027	0.034	4.952

shows the value of new residential building mortgage insured by FHA and VA in 1976. (No information on FmHA Mortgages by lender was found.) Note that nonregulated primary loan originators, mortgage and life insurance companies originated $3.946 billion in FHA and VA loans in 1976. This represents $5.240 billion in property value, or 9% of total new residential property value. The percent of nonregulated primary FHA and VA loans originated through mortgage and life insurance companies will be referred to as V_I'. This figure will be used in calculating penetration rates.

A.4 SECONDARY LOAN MARKET

Three Federal agencies participate in the secondary loan market, buying mortgages from primary mortgage originators. These mortgages are either held in a government portfolio or resold to investors at a later date. The Federal National Mortgage Association, commonly known as "Fannie Mae" or FNMA, is a government-sponsored private corporation whose purpose is to put funds into the mortgage market through secondary market operations. FNMA buys insured and conventional mortgages from primary lenders, financing its operations through the sale of mortgage backed bonds, notes, and stock. FNMA maintains a portfolio of mortgages rather than routinely selling off its acquisitions. In contrast, the Federal Home Loan Bank Board's secondary market operation, known as Federal Home Mortgage Corporation or "Freddie Mac," seeks to stabilize mortgage markets by buying and reselling both insured and conventional mortgages. Freddie Mac is owned by the 12 district Federal Home Loan Banks. Finally, the Government National Mortgage Association, located in the Department of Housing and Urban Development and known as "Ginnie Mae," uses government funds to buy only government-insured mortgages in the secondary market, later auctioning off these mortgages to institutional investors (Congressional Quarterly, Inc. 1979a).

Data are available that describe the outstanding portfolio balances at year-end for each of the three agencies, and the quantity of mortgages purchased during the year (U.S. Department of Housing and Urban Development 1977b). However, these data do not separate building types, nor do they distinguish between new and existing building mortgages. Therefore, it is not possible to estimate precisely the coverage of the new building markets by government agency secondary mortgage purchases. Using data for 1976, the quantity of mortgage purchased in that year is a small percentage of total new building mortgage loans. Thus, coverage of new residential and commercial building markets is likely to be quite low, but we cannot be more precise.

The outstanding portfolio data are not appropriate for inclusion in the penetration rate estimates developed in the next section. The port-

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[1]It was assumed that Farmers Home Administration-financed houses were in the same value range as FHA/VA homes.

folios contain both new and existing building mortgages, and they are year-end stocks resulting from both sales and purchases over a period of years. Therefore, these data are not included in the penetration rates, and the rate estimates will thus be low.

A.5 BUILDING VALUE AFFECTED BY STATEWIDE LOCAL ENERGY CODES

Estimates of the percentage of residential building value affected by statewide energy codes (V_S) and by local codes in states without statewide codes (V_L) are required. The methodology used to derive V_s and V_L is described below.

A.5.1 METHODOLOGY

Total residential building permit value for each state with a statewide code (B_S) is added together and divided by the sum of building permit value in all states to estimate the proportion of building value affected by statewide codes. That is, the estimate is:

$$V_S = \sum_{i}^{n} B_{s_i} \Big/ \sum_{j}^{n+m} B_{s_j} \qquad \text{(A.5)}$$

where $i = 1 \ldots n$ states with statewide energy codes and $j = 1 \ldots n + m$ where $m + n$ equals all states. Code status of states is reported in Construction Review (Dept. of Commerce 1977a). Building permit data sources are reported in Construction Reports (Dept. of Commerce 1977b).

No data are available on building permit values at the local level to estimate the proportion of building permit data affected by local codes in noncode states. Therefore, these values are determined by multiplying the percentage of the population living in code localities in noncode states (P_{LC}/P_s) by the state's building permit value (B_s). The resulting estimates are then summed across all noncode states and divided by the sum of building permit values for all states:

$$V_L = \sum_{j}^{m} \left({}^{P_{LC_j}}/_{P_{S_j}} \right) B_{s_{j's}} \Big/ \sum_{i}^{n+m} B_{s_i} \qquad \text{(A.6)}$$

where $j = 1 \ldots m$ noncode states and $i = 1 \ldots n + m$ whre $n + m$ equals all states.

Data on the percentage of the population living in code localities in noncode states were obtained by calling state energy office officials in each noncode state.

Note that the estimates of the percentage of the population living in code localities in noncode states vary in reliability. Note also that the procedures of estimating local building permit values by population may be biased if building prices vary between code and noncode jurisdictions. If codes add to building costs, then the direction of bias in percentage of residential building value affected by local codes in states without state-wide codes (V_L) should be downward, implying that the V_L estimate is somewhat lower than it should be. As in other cases, the assumptions used gives a conservative, lower bound character to the estimate.

A.5.2 RESULTS

The proportion of building value affected by a state code (V_s) equals 0.69, using 1976 data. The proportion of building value affected by a local code equals 0.16.

A.6 RESULTING PENETRATION RATES

Penetration rates for the Standards are constructed in this section using assumptions about the timing of implementation by the various implementing agencies, the data on institutional coverage developed above, data on code jurisdiction coverage discussed below, and additional assumptions about the overlap between code coverage and coverage by financial institutions and insurance programs. Since no estimates are available for secondary mortgage markets, the penetration rates are lower bound, conservative estimates. The only assumption made which imparts an upward bias is that all financial institutions of stated types are affected by Federal regulatory agencies. All of the assumptions and qualifications made in estimating institutional coverage sections are critical to the penetration rate estimates since the institutional coverage estimates are used in calculating the penetration rates. The direction of any bias from these other assumptions is unknown. The relative magnitude of the various biases is also unknown.

A.6.1 METHODOLOGY

Penetration rates are estimated by adding up the percentage of the residential building market assumed to be in compliance in each of two years. By 1981, we assume that all financial institution regulators will be in compliance, resulting in primary mortgage lender compliance if the lender is federally regulated. Thus, mortgages let by commercial banks, savings and loans, mutual savings banks, and Federal credit agencies are in compliance. In addition, Federal insurance programs are assumed to be in compliance. Thus, the percentage of total new residential building value financed through FHA and VA insured loans let by nonregulated primary lenders is added to the percentage originated by regulated lenders. FHA and VA loans originated by regulated lenders are already counted; thus, to avoid double-counting of these loans, only those by nonregulated lenders are added at this point.

By 1983, states and localities which currently have energy codes are assumed to have modified their codes to be in compliance with the Federal Standards. Thus, the percentage of property value with new residential buildings which are affected by state standards, and by local standards in states lacking state-wide standards, but which is not already affected by regulated institutions primary mortgages or insured mortgages, can be added to the percentage in compliance in 1981. No data are available on the overlap between buildings constucted in state or local jurisdictions with codes and buildings financed with loans from regulated institutions or loans insured by Federal agencies. Thus, the resulting penetration rate estimate for residential buildings depends upon assumptions concerning how the various components (code jurisdictions, Federal regulation of construction loans and mortgage loans and insurance programs) overlap.

Two assumptions are used to derive penetration rate estimates. First, it is assumed that total overlap exists among the various components. Second, no overlap is assumed.

A.6.2 RESULTS

Assuming total overlap among the components, the estimated residential penetration rate for 1982 would be 66%.[1] However, information exists that indicates the total overlap assumption is unrealistic. It was determined that 9% of total building value in 1976 had mortgages guaranteed by either FHA, VA or FmHA and mortgage funds that came from nonfederally regulated financial institutions. Thus, a more realistic

[1]This penetration rate was used as the upper bound for residential units in 1982.

estimate of the penetration rate for 1982 would be 75%.[1] Using the same approach, for 1983 to 2000 the estimated penetration rate would be 85%. Given the basic assumptions that were used to derive penetration rates, these penetration rate estimates are a lower bound estimate for the residential sector. An upper bound estimate for this alternative would be 100%. This estimate results from a no overlap assumption.

There are several limitations associated with this analysis. First, data deficiencies exist and some data assumptions were made to derive a residential penetration rate estimate. Second, 1976 data were used. The validity of these penetration rate estimates depends, in part, on the representativeness of the 1976 data. Third, it is likely that if Federal mortgage and construction loan funds are cut off for a recalcitrant area, some construction that would have used federally regulated funds would find other funding sources. The extent to which that would happen is unknown at this point. However, this effect may lead to a lower penetration rate than the rates discussed above because some building may defy the Standards if they are confident of receiving non-federally regulated funds. Fourth, even though only 15% of new building value is FHA, VA or FmHA insured, a higher percentage of building meets FHA, VA, FmHA standards. Builders will build speculation units to the FHA, VA, FmHA standards so that they do not foreclose that type of buyer. This effect will increase the penetration rate. However, the magnitude of the effect is unknown.

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[1]Based on comments of code enforcement officials this calculated estimate was deemed too high and was, therefore, not considered achievable in 1982.

APPENDIX B METHODOLOGIES FOR ESTIMATING STATE AND LOCAL IMPLEMENTATION COSTS OF THE STANDARDS

This appendix presents the methodology used to estimate state implementation costs and local implementation costs. The estimates of costs incurred by state governments for implementation of the Standards are based on information obtained from 26 states on the costs of implementing state energy codes under DOE's State Energy Conservation Program. The cost figure for each state was then divided by the dollar value of building permits issued in that state in 1976. This provided, for each state, an estimate of the implementation cost per dollar of building permits. Next, the mean implementation cost per dollar of building permits was calculated for all 26 states.

This estimate of the mean implementation cost per dollar of building permits was used to compute the maximum estimate of the costs to states, nationwide, of implementing the Standards via the certification process. The maximum estimate was based on the assumption that each state would incur this mean implementation cost regardless of its present code status. Thus, to derive the estimate of state implementation costs nationwide, the mean implementation cost per dollar of building permits was multiplied by the total value of building permits issued in the Nation during 1976 (the most recent year for which data are available).

Costs previously incurred by local jurisdictions in implementing energy codes are assumed to provide good estimates of the costs likely to be associated with implementation of equivalent codes with the Standards. High and low estimates of such costs have been developed in the following manner. The high estimate assumes that every jurisdiction would experience costs similar to those incurred by jurisdictions which previously adopted codes. Denote this cost as C_I, and denote the value of all building construction put in place per year in such jurisdictions as B_I. The cost estimate for such a jurisdiction is

$$C = C_I/B_I.$$

C is estimated by the mean value of C_I/B_I for a sample of six local jurisdictions. Two of these jurisdictions are located in states with statewide energy codes; two are in states without statewide energy codes where local energy codes have been adopted; and two have neither statewide nor local codes. Building department officials in each of these jurisdictions were interviewed by telephone and asked to estimate the cost or implementing a Federal Energy Standard based on their experience with code processes. The interviews took place before precise details on the Standards were made available. The local officials also provided data on the value of construction put in place by the jurisdiction in 1978.

To get nationwide costs, the cost estimate C for localities is multiplied by the value of building permits for each state in 1976, and summed across states:

$$C_H = \sum_{i=1}^{51} C \times B \qquad i = 1...51 \text{ states.}^1$$

The low cost estimate assumes that states which already have energy codes, and localities in noncode states which already have codes, will experience no additional costs to implement the Federal Standards. Therefore, costs are incurred only by noncode localities in noncode states. Let P_N stand for the percent of a noncode state's population living in local jurisdictions lacking energy codes. The total low implementation coses estimate is thus:

$$C_L = \sum_{j=1} C \times (B_j \times P_{Nj}) \qquad j = 1...\text{noncode states.}$$

[1]The District of Columbia is treated as a state, resulting in 51 states.

APPENDIX C SOCIOECONOMIC IMPACTS

Appendix C presents impacts of the Standards on the national economy and on regional economies as represented by selected BEA regions. At the national level, impacts are shown for each of the five hypothesized penetration rates described in section 3.3. Where possible, impacts on the national level by components, of an implementation program were identified. At the regional level, analysis was conducted to determine the change in employment and earnings resulting from the implementation of the Standards. This analysis was carried out for alternative penetration rates. In addition, the relationship between sanctions, incentives and regional impacts was identified. Where possible, national level impacts by components of an implementation program where identified.

At the regional level, analysis was conducted to determine the change in employment and earnings resulting from the implementation of the Standards. This analysis was carried out for alternative penetration rates. In addition, the relationship between sanctions, incentives and regional impacts was identified.

C.1 NATIONAL ECONOMIC IMPACTS

This section first presents the methodology used to estimate economic impacts[1] of implementing the Standards. Direct impacts of the Standards and their impacts on key national economic variables, selected industries, employment and consumers of new and existing houses are then presented.

Before describing the methodology used to estimate the impacts of the Standards, a brief discussion is in order on how implementing the Standards will force change. Throughout the period of analysis and the setting of the Standards, the life-cycle costs (LCC)[2] of owning and space conditioning buildings have been an important consideration. It was determined during the preparation of TSD No. 8, Economic Analysis (DOE 1979b) that buildings currently under construction have higher LCC than if additional resources in the form of more energy-efficient options were added with their resulting energy savings. Based on this analysis, the Standards for residential buildings have been set at the minimum in LCC (see DOE 1979b for the assumptions embodied in the LCC analysis).

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[1]Economic impacts include not only the direct changes in energy and capital cost for all new buildings, but also the indirect effects fostered by implementing the Standards.

[2]Life-cycle costs are defined as the total discounted cost of purchasing and space conditioning a building over the life of the building.

Thus, a move from a pre-Standards house to a house in compliance with the Standards would be accompanied by a redistribution of expenditure away from the energy sector toward the building sector and an increase in effective disposable income to the building owner (i.e., the savings in LCC). These are the direct impacts of the Standards. Other impacts are experienced throughout the economy as builders change the composition of materials in buildings to comply with the Standards. Also, the disposition of the "additional" income to the building owner generates further economic activity.

C.1.1 METHODOLOGY

This section discusses the methodology used in estimating impacts of the Standards on key macroeconomic variables, industry, employment, and individual consumers.

C.1.1.1 MACROECONOMICS, INDUSTRY AND EMPLOYMENT

The analysis presented in this section has been conducted using a methodology developed over the past 3 years on projects for DOE. The primary objective of those projects has been to measure nationwide impacts of specific Federal conservation programs on affected groups. Specifically, the methodology incorporates a national input-output model, EXPLOR, and measures impacts at the national level on energy use, employment, investment and trade with special emphasis on energy use and employment.[1] Analyzing the impacts of conservation programs within a model of the entire economy assures that the system-wide impacts of policies that may otherwise be analyzed in a vacuum are measured. To achieve this goal, estimates of direct energy changes and costs that have been developed in detailed analyses of buildings[2] that comply with the Standards have been used as input to EXPLOR. The model was then run with the direct Standards-related changes made to the pertinent data inputs of the model. The results from these runs were then compared to the results determined for the baseline economic environment (see section 4.2.1) to determine the net system-wide impacts of the Standards.

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[1]See section 4.2.1 for a detailed description of the methodology.
[2]See Chapter 4 of TSD No. 8, Economic Analysis.

C.1.1.2 CONSUMER METHODOLOGY

The methodology for determining impacts on the consumer focused on four areas: capital costs, net present value (NPV) of the Standards, consumer response and equity implications.

C.1.1.2.1 CAPITAL COSTS

Capital cost increases in residential and commercial construction due to the Standards were estimated and discussed in detail in TSD No. 8, Economic Analysis. Capital cost increases were estimated by determining the additional materials and labor required to construct a residential and commercial structure that complies with the Standards. These additional materials and labor were then costed out to determine the capital cost increase due to the Standards.

C.1.1.2.2 NET PRESENT VALUE

The methodology used to determine the net present value (NPV) of the Standards' investment to the consumer is also discussed in detail in TSD No. 8, Economic Analysis. The NPV adjusts for the time value of money by use of a discount rate. Once discounted, the value of the future potential energy savings and the additional capital cost attributed to the Standards can be compared directly. The difference between the discounted energy savings and additional capital costs is the NPV. Briefly, all the benefits of the Standards were assessed over the life of the structure. The present value of the benefits were then compared with the present value of all the costs of the Standards. The greater the benefits relative to the costs, the greater the net present value of the Standards. Benefits include the potential energy savings over the life of the house; costs include the increased first cost of the house.

C.1.1.2.3 CONSUMER RESPONSE

This section explains the methodologies used to estimate consumer response to the Standards that is reflected in the residential housing market. Two areas are analyzed, property values and housing starts. The analysis focused on these two areas because the impact of the Standards on property values and housing starts reflects overall consumer

response to the Standards, and because secondary data were available to estimate the impacts on these two areas. Impacts on property values and housing starts were analyzed in relation to incentives and sanctions that the government could adopt to facilitate implementation and enforcement of the Standards. The types of sanctions and incentives being considered are discussed in section 3.1.

Use of sanctions and incentives can range from "full" sanctions to no sanctions and from "full" incentives to no incentives. This analysis proceeds on several assumptions concerning sanctions and incentives: (1) Full sanctions are defined as the sanctions described in the Act. (2) A sanction between the extremes of full and none cuts off all state funds via the Pub. L-395 programs. (3) Full incentives are defined as some combination of a tax credit and information program such that consumers of buildings in compliance with the Standards will experience no economic disadvantage relative to consumers of houses not in compliance; i.e., any additional costs to consumers from the Standards will be completely offset. (4) Partial incentives are defined such that 50% of additional cost to consumers due to the Standards will be offset with a tax credit or information program. Thus, consumer response to the Standards will depend on the types of sanctions and incentives that are implemented as well as some other factors which are specifically discussed in the material on property values and housing starts.

o Methodology to Determine Impacts on Property Value

The impact of the Standards on property values depends on the extent to which consumers evaluate their housing costs based on life-cycle costs or first costs, and on the types of sanctions and incentives adopted for the program. The relationship between these two factors and property values is discussed here.

Simply speaking, first cost refers to the price a consumer pays for a house. Operating costs include maintenance costs, utility bills, energy expenditure and other operating expenses. Life-cycle costs are the sum of first costs, or capital costs, plus operating costs summed over an assumed lifetime of a house. For example, the $60,000 sales price of a house reflects capital costs, but not necessarily operating expenses. For purposes of analysis, suppose this house uses energy inefficiently. Also, assume a second house is identical to the first in every respect (location, size, quality, neighborhood, etc.) except it uses energy efficiently and sells for $62,000. Given reasonable assumptions about energy use and prices, it is quite possible that the more expensive energy-efficient house will have lower life-cycle costs than the less expensive (i.e., lower first cost) energy-inefficient house.

The relationship between property values (i.e., housing first cost) and consumer response to life-cycle costs is crucial for the estimation of the impacts of the Standards on property values. The change in real estate values due to the Standards will depend on the perceived value consumers place on improved housing efficiency. If consumers believe the benefits of the Standards (reduced energy bills) are outweighed by the costs (increased housing first costs), they will turn to older houses that do not comply with the Standards, thus bidding up the price

of that housing. If consumers perceive that benefits outweigh the costs, they will bid up the price of housing that is in compliance with the Standards relative to older housing which is not in compliance

The impact of the Standards on property values also depends on what types of sanctions and incentives are adopted insofar as they significantly affect the penetration rate of the Standards. The more housing built to the Standards, the greater the impact on the first cost of housing. Sanctions and incentives that induce a high penetration rate will therefore indirectly affect property values.

Property value impacts will also depend on whether tax credits for purchasing a house which meets the Standards are adopted. To the extent that tax credits are offered, this will, in the short run, cause an increase in the property value of housing that complies with the Standards.

It should be clear then that impacts on property values depend in large part on whether first costs or life-cycle costs are more relevant to the consumer's decision-making process. The analysis tested two hypotheses regarding this question. The first hypothesis states that energy-efficient dwellings sell at a higher price than conventional dwellings, all other things equal. Confirmation of this hypothesis implies that consumers evaluate life-cycle benefits from energy conserving improvements when deciding to purchase a house. Rejection of this hypothesis would indicate that consumers lack sufficient information to evaluate the life-cycle benefits from the energy-conserving features of dwellings. The second hypothesis states that individuals in SMSAs with above-average energy prices or above-average heating or cooling loads will be most likely to evaluate the life-cycle benefits (compared to just the change in first cost) from energy-conserving improvements. Results from testing this hypothesis, in conjunction with assumed sanctions and incentives, allow us to determine the impact of the Standards on property value.

A two-step procedure was used to estimate the impacts on property values and test the two hypotheses. Using data on 11 SMSAs[1] from the Bureau of Census' Annual Housing Survey - SMSA sample for 1976-1977, the first step was to derive a measure of individual housing unit energy efficiency. Multiple regression techniques were used to determine the influence of a number of independent variables upon individual household energy expenditures across sampled SMSAs. These variables included total heating and cooling degree-days, energy prices, homeowner and renter characteristics (e.g., income) and housing unit characteristics (e.g., number of rooms). Unfortunately, the data base used in this report did not contain information regarding the energy efficiency of residential structures. However, it is reasonable to hypothesize that

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[1]The 11 SMSAs analyzed are: Allentown, Bethlehem, Easton, Pennsylvania; Seattle, Washington; New York, New York; Raleigh, North Carolina; Buffalo, New York; Grand Rapids, Michigan; Sacramento, California; Denver, Colorado; Honolulu, Hawaii; Houston, Texas; and St. Louis, Missouri.

the energy efficiency of a home or an apartment building will affect the level of expenditures on energy. Consequently, statistical estimates of the relationships between energy expenditures and other variables should also reveal information about the energy efficiency of individual dwellings, even though an energy-efficiency variable was not included in the regression equation as an independent variable.

In order to construct an indirect measure of the energy efficiency of residential units, it was assumed that the only determinant of energy expenditures not reflected in the regression equation was housing energy efficiency. Based on this assumption, the variation in individual energy expenditures that is not explained by the independent variables in the regression equation can be attributed to the energy efficiency of residential structures. A measure of this residual variation in energy expenditures is contained in the error term of the regression equation. Consequently, this term was employed to construct a housing energy-efficiency variable.

The second step of this procedure used the derived housing unit energy efficiency variable in another multiple regression analysis which related property values to various characteristics of dwellings including size, location, quality, and energy efficiency. The relationship between property values and energy efficiency will determine if energy-efficient dwellings sell at a higher price (i.e., first cost) than conventional dwellings, all other things equal. This relationship is also used to estimate how much consumers are willing to pay for improvement in energy efficiency.

o Methodology to Determine Impacts on Housing Starts

The methodology used to estimate the impact of the Standards on housing starts requires an estimate of the costs of building a dwelling that complies with the Standards and an estimate of the elasticity of demand for housing starts with respect to the price of the dwelling. These two pieces of information will reveal how consumer demand for housing starts will be affected if the Standards cause an increase in first costs. For example, suppose the elasticity of demand for housing starts with respect to first costs equals -1.0. This means that a 10% increase in price results in a 10% decrease in demand. Suppose that the Standards increase the first costs by 1%; if the elasticity is -1.0, then the demand for housing starts could decrease by as much as 1%.

Estimates of the costs of building a house that complies with the Standards were obtained from TSD No. 8, Economic Analysis. Tables A-11 and A-12 of that document show incremental cost estimates for ten cities in the United States for both gas-heated and electrically-heated houses.

The elasticity of demand for housing starts was estimated from a demand equation that was derived using multiple regression techniques. Data for the analysis was gathered for 17 SMSAs (1973 to 1975) from the Bureau of Census, the Bureau of Labor Statistics, the Federal Power Commission, the American Gas Association and the F. W. Dodge Construction Data Manual. Data on housing starts were related to data on housing structure prices (i.e., first cost), interest rates, construction costs, and other relevant variables.

The change in housing starts due to the Standards will also depend on the perceived value consumers place on improved housing efficiency. If consumers perceive that the benefits of the Standards are outweighed by the costs, demand for older housing that does not comply with the Standards will increase. If consumers perceive that the benefits outweigh the costs, demand for housing in compliance will increase relative to older housing. In the former case, housing starts will decrease because people will not be willing to pay for the improved housing efficiency. In the latter case, housing starts will increase to meet the increased demand for housing that does comply with the Standards.

Housing starts also depend on the penetration rate of the Standards and, therefore, on the types of sanctions and incentives adopted. The more housing built to the Standards, the more a potential homebuyer is forced to consider the prospect of buying such a house. Thus, the greater the penetration rate, the greater the potential impact of the Standards on housing starts.

Any tax credit program will affect housing starts. A subsidy to buyers that purchase housing complying with the Standards will cause an increase in housing starts, assuming other factors are constant.

Finally, the relative impact of the Standards on housing starts depends on conditions in the residential housing market. Changes in national economic conditions could dramatically alter the impacts of the Standards on housing starts. For instance, if the Federal Reserve tightens the supply of money and credit into the economy concurrent with the implementation and enforcement of the Standards, the impact of the Federal Reserve's actions on housing starts could swamp the impact of the Standards on housing starts.

C.1.1.2.4 EQUITY IMPACTS

The Standards will have different impacts on different income groups through society. These impacts, called equity impacts, will largely depend on three factors: 1) variation in rates of discount for future expenditures between income classes, 2) typical lending practices of financial institutions, and 3) types of government sanctions and incentives adopted to implement and enforce the Standards.

The procedure used to assess the impact of the Standards on consumer equity was largely qualitative. Information from the housing starts analysis and the property values analysis was used to qualitatively discuss the impacts of the Standards on low, middle, and upper income groups. In addition, related research efforts were reviewed and key results relevant to this research were used to examine the relationship between discount rates and equity impacts of the Standards.

C.1.2 MACROECONOMIC IMPACTS

The ORNL energy demand models (see TSD No. 8, Economic Analysis) estimate dollar values of saved energy, increased capital costs and costs of implementing and enforcing the Standards for each of the hypothesized penetration rates discussed in Chapter 3 over the period 1980-2020. These dollar flows are all discounted[1] to the present to determine the constant dollar value of implementing the Standards (i.e., the NPV to the Nation).

Energy savings are as shown in section 5.3. The value of the saved energy was determined assuming Energy Information Administration (EIA) high-price projection (TSD No. 8, Economic Analysis, Chapter 5). Increased capital costs of buildings have also been discussed in detail in TSD No. 8, Chapter 4. A detailed discussion of expected implementation and enforcement costs appears in this document in section 3.3.

The NPV to the Nation of implementing the Standards under each of the five hypothesized implementation schedules is shown in Table C-1. Alternatives associated with each penetration rate and whether it is the high or low estimate are shown below the penetration rate designator.

The results in Table C-1 show what had been expected based on the analysis done on individual buildings. That is, if buildings were constructed with more energy-efficient options, the LCC of owning and space conditioning those buildings would decrease. The aggregate sum of all of the decreases in LCC for each building is the sum of rows 1 and 2 of Table C-1. It is clearly shown in this table that the additional costs incurred to implement and enforce the Standards do not change the sign of the NPV calculation. Also it is clear that the fewer buildings (i.e., slower penetration rate) that comply to the Standards, the lower the NPV to the Nation.

A measure of the value of the direct effects of the Standards on energy and capital has been shown in Table C-1. Net impacts on key macroeconomic variables by penetration rate will now be shown in Table C-2 for 1985 and 1990. As can be seen, the effects on those variables are very small relative to the baseline forecast. Virtually all the changes are less than 0.1% except for the building construction sector, which is directly affected by the increased value of construction and trade balance which only shows large percentage movements in 1990 because the expected trade balance in 1990 is close to zero. The conclusion to be drawn from this table is that the Standards will have a positive effect on employment, GNP, trade balance, etc., but at least at this macrolevel the impact will not be great relative to what the economy is expected to be in 1985 and 1990. Beyond 1990 the impact of the Standards can only be more positive as the stock of energy-efficient buildings grows relative to the amount of new construction.

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[1]All dollar flows are discounted at a real rate of 10% per the Office of Management and Budget (OMB).

TABLE C-1: NET PRESENT VALUE OF IMPLEMENTING THE STANDARDS
(Billions 1978 Dollars)

	Implementation Schedule				
	PR-1	PR-2	PR-3	PR-4	PR-5
Component of NPV	High Alt. 3 & 4	High Alt. 2	Low Alt. 3	High Alt. 1 Low Alt. 2 & 4	Low Alt. 1
Energy Saved	24.73	21.56	19.11	12.52	2.26
Capital Investment	-13.78	-11.37	-9.65	-5.81	-0.96
Implementation & Enforcement	-0.38	-0.33	-0.31	-0.21	-0.05
NPV	10.57	9.86	9.15	6.50	1.25

TABLE C-2: MACROECONOMIC IMPACTS OF IMPLEMENTING THE STANDARDS
(Dollar Values are in Millions of Dollars)

		Absolute Change (%)				
		PR-1	PR-2	PR-3	PR-4	PR-5
Variable (units)	Year	High Alt. 3 & 4	High Alt. 2	Low Alt. 3	High Alt. 1 Low Alt. 2 & 4	Low Alt. 5
Employment	1985	109 (0.09)	85 (0.07)	63 (0.05)	27 (0.02)	16 (0.01)
(1000 jobs)	1990	119 (0.10)	88 (0.07)	71 (0.06)	38 (0.03)	16 (0.01)
Employment Income	1985	2296 (0.10)	2316 (0.08)	1696 (0.06)	707 (0.02)	436 (0.01)
(nominal dollars)	1990	4576 (0.11)	3367 (0.08)	2683 (0.06)	1396 (0.03)	583 (0.01)
Net Final Demand (GNP)	1985	1134 (0.07)	801 (0.05)	501 (0.03)	39 (0)	0 (0)
(1970 dollars)	1990	1504 (0.07)	1041 (0.05)	767 (0.04)	274 (0.01)	18 (0)
Household Expenditures	1985	216 (0.02)	170 (0.02)	120 (0.01)	20 (0)	0 (0)
(1970 dollars)	1990	192 (0.02)	138 (0.01)	107 (0.01)	50 (0)	0 (0)
Domestic Production	1985	2622 (0.08)	1969 (0.06)	1345 (0.04)	500 (0.01)	500 (0.01)
(1970 dollars)	1990	2725 (0.07)	1885 (0.05)	1394 (0.04)	654 (0.02)	502 (0.01)
Building Construction	1985	1542 (1.5)	1265 (1.2)	1031 (1)	518 (0.5)	132 (0.13)
(1970 dollars)	1990	1708 (1.6)	1334 (1.2)	1133 (1.0)	642 (0.6)	91 (0.08)
Trade Balance	1985	547 (3.0)	497 (2.8)	487 (2.7)	374 (2.1)	76 (0.4)
(nominal dollars)	1990	2168 (89.8)	1860 (77.8)	1620 (67.1)	1150 (47.7)	80 (3.3)

C.1.3 INDUSTRY IMPACTS

The sectors of the economy whose production is most affected by the Standards are shown in Table C-3 by penetration rate for 1985 and

1990. Electric utilities show the largest decreases relative to the base case and these decreases accumulate as the inventory of energy-efficient buildings grows over time. It is important to note here that this does not mean that there will be negative growth or jobs will be lost in the electric utilities sector, because electric utilities will continue to increase production, but at a lower rate than would have been forecasted without energy performance standards. Impacts on natural gas utilities have been held at zero under the assumption that all savings in natural gas would preferentially displace imports.

Building construction and electric appliances move as expected as the Standards add to building costs and some electric appliances are downsized.

Cement and log and sawmill products increase production as more cement is used to add to the thermal mass of buildings, and the movement to 2 x 6 walls forces the use of additional lumber to frame houses.

It should be noted that the impacts on those sectors associated with construction activity do not change very much from 1985 to 1990; however, for electric utilities, where the impact accumulates as the stock of energy-efficient buildings grows, there is a large difference in the impacts between 1985 and 1990. This is also true of the service sector as the impacts on this sector are dependent on cumulative increases in effective disposable income that accrue to building owners over time

An in depth examination of the effects on building material supplies of implementing the Standards for a representative year has been done and reported on in the Economic Analysis of the Standards, TSD No. 8, Chapter 6.

C.1.4 EMPLOYMENT IMPACTS

The present analysis has shown that the Standards will have a positive impact on employment in general (Table C-2). Some sectors of the economy are more affected than others. Electric utilities will employ 7,000 fewer people by 1990 (PR-1) than if baseline growth rates had prevailed. The electric appliances sector is also expected to have a slight decrease in its growth. The impact on employment by selected sectors of the economy are displayed in Table C-4 for each of the five penetration rates.

TABLE C-3: CHANGES IN DOMESTIC PRODUCTION (Millions of 1970 Dollars)

Sector	Year	PR-1 High Alt. 3 & 4	PR-2 High Alt. 2	PR-3 Low Alt. 3	PR-4 High Alt. 1 Low Alt. 2 & 4	PR-5 Low Alt. 1
Electric Utilities	1985	-286	-243	-239	-144	-34
(SIC 492, Part 493)	1990	-614	-530	-502	-292	-64
Natural Gas Utilities[a]	1985	0	0	0	0	0
(SIC 492, Part 493)	1990	0	0	0	0	0
Building Construction	1985	1542	1265	1031	518	132
(SIC Part 15, 16, 17)	1990	1708	1335	1133	642	91
Electric Appliances	1985	-283	-281	-285	-216	-66
(SIC 361, 312)	1990	-290	-284	-283	-230	-21
Distributive Trade	1985	218	169	128	48	18
(SIC 50, 52-59)	1990	215	153	130	62	15
Service	1985	539	437	343	172	87
(SIC 60-67)	1990	757	603	507	308	100
Rubber and Plastic	1985	247	238	231	222	226
(SIC 30)	1990	233	223	217	210	210
Cement	1985	266	240	217	171	141
(SIC 324-329)	1990	271	236	216	172	128
Log and Sawmill	1985	130	118	108	89	82
(SIC 241, 242)	1990	136	120	111	93	82

[a]Domestic natural gas consumption was held constant and savings were assumed to be taken from impacts.

TABLE C-4: CHANGES IN EMPLOYMENT (1000 Jobs)

Sector	Year	PR-1 High Alt. 3 & 4	PR-2 High Alt. 2	PR-3 Low Alt. 3	PR-4 High Alt. 1 Low Alt. 2 & 4	PR-5 Low Alt. 1
Electric Utilities	1985	-4	-3	-9	-2	-0.5
(SIC 491, Part 493)	1990	-7	-6	-6	-3	-0.7
Natural Gas Utilities[a]	1985	0	0	0	0	0
(SIC 492, Part 493)	1990	0	0	0	0	0
Building Construction	1985	58	48	39	20	5
(SIC Part 15, 16, 17)	1990	64	50	43	24	3
Electric Appliances	1985	-7	-7	-7	-5	-2
(SIC 361, 312)	1990	-6	-6	-6	-5	-0.5
Distributive Trade	1985	13	10	8	3	1
(SIC 50, 52-59)	1990	12	9	7	3	8
Service	1985	28	23	18	9	5
(SIC 60-67)	1990	37	30	25	15	5
Rubber and Plastic	1985	5	5	5	4	4
(SIC 30)	1990	4	4	4	4	4
Cement	1985	7	6	5	4	3
(SIC 324-329)	1990	7	6	5	4	3
Log and Sawmill	1985	3	3	3	2	2
(SIC 241, 242)	1990	3	3	2	2	2

[a]Domestic natural gas consumption was held constant and savings were assumed to be taken from impacts.

Building construction activity spurred by the implementation of the Standards is expected to create about 60% of the total employment impacts. The rest of the employment increase occurs in other allied service industries whose output is expected to increase because of a redistribution of monies saved by reduced fuel consumption.

If we examine the three sectors with the greatest positive and negative changes in domestic production, we get some insight into why employment would increase with an energy standard. Changes in domestic production, employment and a measure of productivity for each sector are shown in Table C-5 for the year 1990 (PR-1) for electric utilities, services, and building construction. Labor productivity measured in terms of dollars of production per worker is approximately four times higher for electric utilities than for the two other sectors whose changes in output is affected the most by the Standards. Thus, a dollar saved on reduced electricity consumption and spent on services or construction has the net effect of creating jobs. Since we assumed that Standards are set that decrease the life-cycle cost of owning a building, there is a redistribution of household expenditure away from electricity, a highly capital-intensive commodity, toward relatively labor-intensive sectors like construction, trade, and services, thus yielding a net increase in employment. In fact, in our analysis employment income has also increased even though the average wage has decreased. This is so because the income generated through the many average paying jobs more than offset the loss of fewer higher paying jobs in electric utilities.

Using the Bureau of Labor Statistics (BLS) Industry and Occupation Matrix, we looked at the distribution of jobs created/lost for each of the three sectors discussed above. For purposes of exposition, we aggregated the 401 job categories listed in the BLS matrix into six major occupations. These are shown in Table C-6.

In each case the total impact on each occupation is positive even though there would be as many as 1,830 fewer operative jobs in electric utilities than if baseline growth in demand had prevailed. Thus it appears as though there will be no undue hardship on any one occupational group brought by the Standards. The occupational groups shown here are highly aggregated. A similar exercise could be conducted with the full BLS matrix to be sure that one or more specific occupations are not severely affected.

C.1.5 CONSUMER IMPACTS

Impacts on individual consumers are described below. Impacts are divided into four areas: increased building capital cost, net present value of the Standards, consumer response and equity implications.

TABLE C-5: MOST AFFECTED SECTORS FOR 1990 (PR-1)

	Domestic Outputs (Million $1970)	Employment (1000 Jobs)	Labor Productivity ($1000/Job)
Electric Utilities	-641	-7	91
Services	757	37	20
Building Construction	1708	64	27

TABLE C-6: DISTRIBUTION OF JOBS CREATED/LOST IN 1990 IN MAJOR AFFECTED SECTORS (1000 Jobs)

Occupation	Utilities	Services	Building Construction	Totals
Professionals	-0.54	10.3	2.3	12.1
Sales Workers	-0.06	1.2	0.4	1.5
Crafts	-1.63	1.7	35.7	35.8
Operatives	-1.83	1.1	5.3	4.6
Laborers	-0.64	0.8	8.7	8.9
Others	-2.30	22.1	11.1	30.9
Totals	-7.0	37.0	64.0	94.0

C.1.5.1 IMPACTS ON CAPITAL COSTS

The Standards will affect construction practice by increasing the required level of ceiling, wall and floor insulation and requiring multiple window glazing. Ceiling insulation will be increased to a maximum of R-38 from average current building practice of R-19 in most parts of the Nation, and wall insulation increased from R-11 to R-19 and, in the coldest climates, to R-25. The Standards also require floor insulation of R-11 and R-19, as well as double and triple glazing of windows. All of these insulation measures are already used by builders in some or many parts of the country. Other than R-25 wall insulation,[1] the most stringent measures are already required by some Federal regulations (such as the Farmers Home Insurance) in some regions of the country to qualify for loans or insurance.

The costs of each of these conservation measures, presented in Table C-7, were estimated by the Oak Ridge National Laboratory (Hutchins and Hirst 1978) and reviewed by Hanscom Associates in Washington, D.C. These estimates are consistent with the results of a survey of insulation costs by the National Association of Home Builders (1979). The cost of conservation was assumed to increase at the rate of inflation.

The conservation investment for a single-story house heated and cooled with different fuel and equipment in alternative localities is presented in column 7 of Tables C-8, C-9, and C-10. On average, the conservation investment is equal to approximately 2% of the first cost of a house that does not comply with the Standards. Column 7 lists the estimated conservation investment, in 1978 dollars, required to achieve the energy conservation levels presented in columns 5 and 6. These investments are for an 1176-sq. ft. single-story house. They will increase as the house size increases. These conservation investments are the difference in costs between the measures in columns 5 and 6 and the costs of conservation using standard construction practice in 1975. The entries in column 7 indicate that for an 1176-sq. ft. wood frame house the cost of the conservation measure is about $1,200 in Minneapolis, between $850 and $1,280 for Chicago and Phoenix, and about $500 or less in Houston and Burbank. The estimates of conservation costs relative to current practice are likely to be high since levels of energy conservation in new residential buildings have increased since 1975. On the other hand, these estimates could be slightly low if 1975 practice used somewhat less conservation for gas-heated houses than for electric-heated houses.

Commercial building construction costs may increase as a result of energy-conserving redesigns. Estimates of those changes in construction costs by building type appear in Table C-11.

[1] The R-25 wall can be achieved with either of two strategies for adding R-6 to an R-19 wall: 1) use of 2 x 6 studs instead of 2 x 4 to accommodate 6-in. thick R-19 batts of insulation; 2) use of R-6 insulating sheathing. Both strategies are used in colder climates.

TABLE C-7: COST OF CONSERVATION MEASURES (Hutchins and Hirst 1978)

Measure	Cost (1978 Constant Dollars)
Add R-11 insulation to ceiling	$0.12 per gross sq. ft.
Add R-8 insulation to ceiling	$0.08 per gross sq. ft.
Increase wall insulation from R-11 to R-19	$0.216 per gross sq. ft. (gross area includes windows and doors)
Increase wall insulation from R-19 to R-27 (replace ordinary sheathing with R-8 insulating sheathing)	$0.264 per gross sq. ft.
Double glazing	$2.16 per sq. ft.
Triple glazing	$2.42 per sq. ft.
Add R-8 to floor	$0.086 per gross sq. ft.

TABLE C-8: NOMINAL CASE ENERGY PERFORMANCE STANDARDS FOR SINGLE-STORY HOUSES HEATED BY NATURAL GAS AND COOLED BY ELECRICITY (Post July 23 Assumptions Used)

1	2	3	4	5			6	7	8	
				Insulation Levels of Nominal Case (R-Value)					Natural Gas Energy Budget	
Climate Region	Representative City	Heating Degree-Days[a]	Cooling Degree-Days[a]	Ceiling	Wall	Floor	Glazing of Nominal Case	Conservation Investment, $1978	Primary Energy, MBtu/sq. ft./yr	Building Boundary, MBtu/sq. ft./yr
1	Minneapolis	8310 (5260)	530 (370)	38	25	—	3	$1,160	66.1	54.5
2	Chicago	6130 (3540)	930 (620)	38	19	—	3	$ 900	42.9	35.0
3	Portland	4790 (1840)	300 (150)	38	19	19	3	$1,050	30.9	25.9
3	Washington, D.C.	4210 (1980)	1420 (1010)	38	19	—	3	$ 900	33.7	22.4
4	Atlanta	3100 (1230)	1590 (1130)	38	19	11	2	$ 900	28.2	18.3
4	Fresno	2650 (770)	1670 (1220)	38	19	—	2	$ 850	31.9	16.1
5	Burbank	1820 (170)[b]	620 (310)[b]	19	11	—	2	$ 380	15.7	7.2
6	Phoenix[c]	1550 (320)	3510 (2960)	38	19	—	3	$1,280	35.8	12.0
6	Houston	1430 (360)	2890 (2240)	30	11	—	2	$ 520	34.4	15.1
7	Ft. Worth[c]	2830 (810)	2590 (2030)	38	19	—	3	$1,280	32.3	15.2

[a]Heating and cooling degree days base 65°F presented; heating degree-days base 53°F in parentheses; cooling degree-days base 68°F in parentheses.

[b]Degree-days for Los Angeles reported.

[c]Under the EIA Medium Price Projections (December 17, 1978) both Phoenix and Ft. Worth would have used double glazing at a conservation investment of $850. Primary energy use was 40.1 and 36.8 MBtu/sq. ft./yr for Phoenix and Ft. Worth, respectively.

TABLE C-9: NOMINAL CASE ENERGY PERFORMANCE STANDARDS FOR SINGLE-STORY HOUSES HEATED AND COOLED BY ELECTRIC RESISTANCE HEATING (Post July 23 Assumptions Used)

1	2	3	4	5			6	7	8	
				Insulation Levels of Nominal Case (R-Value)					Electrical Energy Budget	
Climate Region	Representative City	Heating Degree-Days[a]	Cooling Degree-Days[a]	Ceiling	Wall	Floor	Glazing of Nominal Case	Conservation Investment, $1978	Primary Energy, MBtu/sq. ft./yr	Building Boundary, MBtu/sq. ft./yr
1	Minneapolis	8310 (5260)	530 (370)	38	25	—	3	$1,160	132.2	38.9
2	Chicago	6130 (3540)	930 (620)	38	25	—	3	$1,190	80.0	23.5
3	Portland	4790 (1840)	300 (1010)	38	25	19	3	$1,350	58.5	17.2
3	Washington, D.C.	4210 (1980)	1420 (1010)	38	25	—	3	$1,190	53.7	15.8
4	Atlanta[c]	3100 (1230)	1590 (1130)	38	19	19	3	$1,433	39.6	11.6
4	Fresno	2650 (770)	1670 (1220)	38	19	—	3	$1,280	38.6	11.4
5	Burbank	1820 (170)[b]	620 (310)[b]	30	19	—	2	$ 760	15.1	4.4
6	Phoenix	1550 (320)	3510 (2960)	38	19	—	3	$1,280	38.5	11.3
6	Houston	1430 (360)	2890 (2240)	38	19	—	3	$1,280	33.6	9.9
7	Ft. Worth	2830 (810)	2590 (2030)	38	19	—	3	$1,280	43.0	12.6

[a]Heating and cooling degree-days base 65°F presented; heating degree-days base 53°F in parentheses; cooling degree-days base 68°F in parentheses.
[b]Degree-days for Los Angeles reported.
[c]Under the EIA Medium Price Projections (December 17, 1978) Atlanta used R-11 floor insulation for a conservation investment cost of $1,330 and a primary energy budget of 40.7 MBtu/sq. ft./yr.

TABLE C-10: NOMINAL CASE ENERGY PERFORMANCE STANDARDS FOR SINGLE-STORY HOUSES HEATED AND COOLED BY ELECTRIC HEAT PUMPS

1	2	3	4	5			6	7	8	9	
				Insulation Levels of Nominal Case (R-Value)						Electrical Energy Budget	
Climate Region	Representative City	Heating Degree-Days[a]	Cooling Degree-Days[a]	Ceiling	Wall	Floor	Glazing of Nominal Case	Conservation Investment, $1978	Heat Pump Seasonal COP	Primary Energy, MBtu/sq. ft./yr	Building Boundary, MBtu/sq. ft./yr
1	Minneapolis	8310 (5260)	530 (370)	38	25	—	3	$1,160	1.38	98.3	28.9
2	Chicago	6130 (3540)	930 (620)	38	25	—	3	$1,190	1.52	54.6	16.1
3	Portland	4790 (1840)	300 (1010)	38	19	19	3	$1,050	1.87	34.9	10.3
3	Washington, D.C.	4210 (1980)	1420 (1010)	38	19	—	3	$ 900	1.79	37.7	11.1
4	Atlanta	3100 (1230)	1590 (1130)	38	19	11	3	$1,330	1.82	27.0	7.9
4	Fresno	2650 (770)	1670 (1220)	38	19	—	3	$1,280	2.02	28.6	8.4
5	Burbank	1820 (170)[b]	620 (310)[b]	30	11	—	2	$ 520	2.02	14.6	4.3
6	Phoenix	1550 (320)	3510 (2960)	38	19	—	3	$1,280	1.92	36.0	10.6
6	Houston	1430 (360)	2890 (2240)	38	19	—	3	$1,280	1.83	28.5	8.4
7	Ft. Worth	2830 (810)	2590 (2030)	38	19	—	3	$1,280	1.83	33.9	10.0

[a]Heating and cooling degree-days base 65°F presented; heating degree-days base 53°F in parentheses; cooling degree-days base 68°F in parentheses.
[b]Degree-days for Los Angeles reported.

TABLE C-11: MEAN CAPITAL COSTS BY BUILDING TYPE FROM AIA/RC PHASE 2 DATA

Building Type	Original Capital Cost, $/sq. ft.[a]	Redesign Capital Cost, $/sq. ft.[a]
Assembly	35.50	37.55
Clinic	28.75	29.51
Hospital	59.12	60.78
Hotel/Motel	32.81	32.74
Mercantile	18.78	19.84
Nursing Home	38.09	39.87
Large Office	23.55	24.47
Small Office	30.44	32.64
Restaurant	56.19	57.55
Elementary	36.20	37.89
Secondary	38.60	39.39
Warehouse	14.44	15.33
High-rise	24.10	22.64
Low-rise	21.03	22.58
All	32.62	33.80

[a]Dollars per square foot calculated with the redesigned gross floor area.

C.1.5.2 NET PRESENT VALUE OF THE STANDARDS INVESTMENT

Life-cycle cost analysis shows that the potential energy savings due to the Standards are greater than the added capital costs attributable to them. However, NPV concepts must be applied to these changes in life-cycle costs in order to compare the benefits and costs of the Standards. Estimates of the NPV of houses that comply with the Standards relative to houses that do not were derived. In this way the added capital investment in houses that comply with the Standards is compared to the potential energy savings to determine whether the Standards are a reasonable investment from the consumer's perspective.

NPVs were calculated for the assumed level of the Standards for each building type and climate region to determine if the Standards are economically desirable to those directly affected. NPVs for gas- and electrically-heated residences in selected cities are provided in Tables C-12 and C-13. The analysis assumed an 1176-sq. ft. single-family detached residence and a 3% real discount rate. In all cases the NPV of the Standards investment is greater than zero, indicating that for residential buildings, the benefits of the Standards outweigh the costs, given the various assumptions.

Estimates of NPVs for commercial buildings are listed in Table C-14. The only type of building with a negative NPV is low-rise apartments. Thus, these results indicate that for commercial buildings, the benefits of the Standards, in almost all cases, outweigh the costs.

C.1.5.3 CONSUMER RESPONSE TO THE STANDARDS[1]

This section briefly describes how consumers will respond to the Standards and how that response will affect property values and housing starts. The methodologies used to derive these estimated impacts are discussed in section C.1.1.2.

IMPACTS ON PROPERTY VALUES

The impacts of the Standards on housing values will be small. To determine the impacts, owners of housing in 11 SMSAs were analyzed. A two-step methodology for determining the extent to which consumers evaluate housing based on life-cycle costs has been described. Results derived

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[1]The difference in this analysis and that which appears in TSD No. 8, Economic Analysis, is in the assumption concerning the degree of information possessed by the consumer. This analysis estimates percieved value based on information possessed by the average consumer in 1976. The Economic Analysis assumed perfect information to the consumer and thus a greater willingness to pay for conservation.

TABLE C-12: NET PRESENT VALUE FOR GAS-HEATED RESIDENCES. Basis: 1.176 SQ. FT. SINGLE-FAMILY DETACHED RESIDENCE, 3% DISCOUNT RATE (real)

	Minneapolis	Chicago	Portland	Wash. D.C.	Atlanta	Fresno	Burbank	Phoenix	Houston	Ft. Worth
Capital Cost	1,155	898	1,050	898	903	851	381	1,279	502	1,279
Energy Reduction										
Gas (10^6 Btu)	26.57	18.31	18.86	12.29	17.47	14.14	3.89	6.81	6.80	14.73
Electric (10^6 Btu)	0.59	0.46	0.05	1.03	0.57	1.26	0.14	4.04	1.20	2.73
Net Present Value ($1978)	1,678	1,071	846	649	1,017	953	51	662	533	1,043

TABLE C-13: NET PRESENT VALUE FOR ELECTICALLY HEATED RESIDENCES. Basis: 1.176 SQ. FT. SINGLE-FAMILY DETACHED RESIDENCE, 3% DISCOUNT RATE (real),

	Minneapolis	Chicago	Portland	Wash. D.C.	Atlanta	Fresno	Burbank	Phoenix	Houston	Ft. Worth
Capital Cost ($1978)	1,155	1,194	1,347	1,194	1,432	1,279	760	1,279	1,278	1,279
Energy Reduction (10^6 Btu B.B.)	19.19	15.10	14.68	10.88	15.34	13.19	4.74	8.81	9.46	13.04
Net Present Value ($1978)	4,841	3,524	3,240	2,206	3,361	2,842	721	1,475	1,678	2,796

TABLE C-14: MEAN NPVS FOR COMMERCIAL BUILDINGS

Building Type	NPV, $/sq. ft.
Assembly	0.73
Clinic	1.44
Hospital	3.39
Hotel/Motel	1.84
Mercantile	1.26
Nursing Home	1.02
Large Office	0.99
Small Office	0.85
Restaurant	3.08
Elementary School	0.34
Secondary School	1.36
Warehouse	0.81
High-rise	1.64
Low-rise	-0.06
ALL	1.32

using this methodology indicated that energy efficiency was a significant determinant of property values in five SMSAs: Allentown, Buffalo, New York, St. Louis, and Grand Rapids. The average estimated value of a 30% increase in housing energy efficiency (approximately the increase in housing efficiency that will result from the Standards) ranged from $450 in New York to $1100 in St. Louis. The average over all five cities was $550.

The relationship between property values and energy efficiency for the other six SMSAs was not found to be statistically significant. One can conclude that, in those SMSAs where total heating and cooling loads are high and where energy prices are high, incentives to evaluate life-cycle benefits from energy efficiency are high enough that consumers do consider housing life-cycle costs. Consumers in SMSAs with lower heating and cooling loads and lower energy prices do not have sufficient incentives to gather information on improved housing energy efficiency.

The SMSAs examined fall into one of two groups: 1) SMSAs where consumers demonstrated a willingness to pay an average $550 for a 30% improvement in housing energy efficiency; 2) SMSAs where consumers did not demonstrate a willingness to pay for housing energy efficiency.

The impacts of the Standards on property values are likely to differ between these two generic SMSA groups. To determine what will happen to property values in these two groups, the willingness to pay for a 30% housing energy efficiency improvement must be compared with the additional cost of building houses with a 30% improvement in housing energy efficiency. The estimated average additional cost of building a house complying with the Standards compared with current practice is approximately 2% (see TSD No. 8). If the average new house costs approximately $60,000, then the average additional cost is $1015.

Consider the group of SMSAs with consumers willing to pay, on average, $550 for a 30% improvement in housing energy efficiency. On average, individuals in these SMSAs would be willing to pay less than half of the additional cost of building a house that complies with the Standards. Thus, the perceived life-cycle cost of housing would increase by approximately $465 ($1015 - $550) for this group. For the group that was, on average, willing to pay $0 for a 30% improvement in housing energy efficiency, the perceived cost of housing would rise by $1015.

As a result of the Standards, the first cost of housing would be expected to increase, on average, approximately 2%. However, given that in the short run consumers are generally not willing to pay the full additional cost of the Standards, we would expect that in order to sell houses that comply with the Standards, the houses would have to be slightly discounted. It also seems reasonable to expect that prices of older houses not built to the Standards would be bid up slightly in value because of consumers' unwillingness to pay for the full additional cost of building a house to comply with the Standards.

This discussion on property values has considered only the short-run impacts. In the long run, it would be expected that consumers would

become aware of the full value of housing that complies with the Standards. After some consumers live in housing that complies with the Standards, information will circulate on the true value of a 30% increase in housing energy efficiency. Previous analysis, which is discussed in TSD No. 8, Economic Analysis, has shown that assuming a 3% real discount rate and a set of rising energy prices, the Standards will actually decrease the life-cycle cost of housing. Under this scenario, the price (first cost) of new housing complying with the Standards will rise by the full 2% additional cost, and the price of older houses not built to the Standards may decrease slightly because of the relative increase in demand for housing that complies with the Standards.

How do government sanctions and incentives affect these impacts? A range of sanctions and incentives exist. For the purpose of this analysis, suppose that sanctions and incentives can be imposed such that 100%, 60%, or 20% of new buildings comply with the Standards. Further, suppose that incentives can be granted such that 100%, 50%, or 0% of the additional housing cost to consumers due to the Standards is subsidized.

The impacts described thus far assume a 100% penetration rate. With 20% of new residential construction in compliance with the Standards, consumers may be able to choose from three types of housing: 1) older homes which may or may not be energy-efficient, 2) new homes which comply, and 3) new homes which do not comply. This penetration rate, in the short run, will have less impact on property values than the 100% penetration rate.

In those localities where consumers evaluate housing costs on a life-cycle basis, property values for houses in compliance with the Standards would be expected to increase by the full additional cost of 2%. These houses would not be discounted because, given that only 20% of new residential construction complies with the Standards, a sufficient number of consumers would be willing to pay the full additional 2%. In these localities the first cost of 20% of new housing would increase by approximately 2%. In those localities where consumers tend not to evaluate housing life-cycle costs, new construction prices may be discounted from the full 2% increase in the short run. In that case, the first cost of 20% of new housing would increase by less than 2%.

In the long run, one would expect that information on the value of housing energy efficiency would circulate to consumers and the penetration of the Standards would increase as builders respond to consumer demand for improved housing energy efficiency. Property value impacts would then be described by the long run, 100% penetration rate scenario discussed above.

With 60% of new residential construction complying with the Standards, we would expect the effects to be somewhere between the 100% and 20% cases. The long-run impacts would not vary from the 100% or 20% penetration rate scenarios.

The analysis of the effect of the three incentives (100%, 50%, 0% subsidized costs) on the impacts of the Standards on property values is based on the assumption that 100% of new residential construction complies with the Standards.

It was mentioned earlier that the perceived life-cycle cost of new housing would increase by approximately $465 as a result of the Standards in those areas that tend to evaluate housing life-cycle costs. If these consumers were given a $1015 tax credit, the net perceived life-cycle cost of new housing would decrease by $550. Under this scenario, property values associated with housing complying with the Standards would be expected to increase by more than the 2% additional building cost in the short run.[1] This would occur because the decline in housing cost would increase housing demand. This would create a temporary shortage and cause the price to increase.

In localities where consumers tend not to consider housing life-cycle costs, the net perceived change in housing cost after a $1015 tax credit would be $0. Under this scenario, property values associated with housing complying with the Standards would be expected to increase by the 2% additional building cost.

In the long run, tax credits would be expected to increase the demand for new housing. The first cost of all new housing would be expected to increase by the 2% additional building cost.

Assuming a 50% cost differential subsidy, new housing first costs would increase in those localities that tend to consider life-cycle costs by the full 2% additional building cost in the short run. Localities where life-cycle costs are not considered can expect to see, also in the short run, the price of new housing discounted slightly. In the long run, the tax credits would be expected to increase the demand for new housing, as well as increase all new housing property values by, on average, 2%.

The zero incentive case has already been addressed because the first property value impacts that were discussed assumed that tax credit incentives equal zero.

A public information program could also be used as an incentive. An effective program would inform consumers about the building's LCC benefits associated with the Standards, and thus, on average, consumers would perceive the building's increased capital cost would be outweighed by benefits from the Standards.

With an effective public information program and no tax credits, the price of housing that complies with the Standards would increase by approximately 2% in the long and short run. With both full tax credits

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[1]Immediately after the house complying with the Standard is purchased, the market value of the house will drop by an amount equal to the tax credit. Once information on the value of the house is generally available, the base will again increase in value.

and a public information program, property values of housing in compliance would increase by more than 2% in the short run and by about 2% in the long run.

Finally, we need to consider the impact of invoking sanctions. The first sanction presently written into the Act suggests that all federally controlled mortgage funds would be denied to a recalcitrant area or builder. This sanction would cause a substantial reduction in housing starts if invoked. Consumers' choices in housing would be narrowed to existing houses and new housing starts that can not be controlled by federally regulated agencies. Thus, the sanction would cause a relative increase in demand for the remaining housing, and property values would increase substantially. A quantitative estimate of the increase in property values is not available at this time.

Another sanction to be considered is a cut-off of state funding under the Pub. L. 94-385 Federal program. If invoked, this sanction is expected to have only a small impact on property values. A decrease in state receipts may affect state programs, but unless state taxes are raised, it probably would not have a direct impact on property values. If state taxes were increased, the income effect may cause a slight decrease in housing demand and, therefore, a slight decrease in property values in the short run.

It is important to note the limitations of this analysis and thus its conclusions. For one, inferences are made about nationwide impacts from data on 11 metropolitan areas. While these SMSAs were chosen with geographical, climatic, economic, and social variation in mind, the representiveness of the sample was not tested statistically. Also, conclusions were reached on impacts expected in the 1980s based on 1976-1977 data. Unfortunately, that was the most recent information available. As a result, the impacts presented are preliminary and could change with more recent information and as information for more cities becomes available. In general, one would expect that the bias in these results, because 1973-1976 data were used, is in the direction of negative impacts. That is, because of recent increases in energy prices, one would expect that the results overstate any negative impacts of the Standards.

Another limitation of the analysis is that the statistical results that were used to estimate the willingness to pay for increased housing energy efficiency are based on a sample of new and existing housing. If the average energy efficiency of this sample of homes is significantly below that of 1975 practice, the $550 estimate may be overstated.

IMPACTS ON HOUSING STARTS

The impact of the Standards on housing starts will be determined by three factors: 1) the extent to which consumers evaluate housing costs based on life-cycle costs or fixed costs; 2) the types of sanctions and incentives adopted to implement and enforce the Standards; and 3) the

status of the residential housing market. The following briefly discusses impacts on housing starts in relation to these factors.[1]

To determine the impact of the Standards on housing starts, we first determined the price elasticity of demand for houses, i.e., the relationship between increases in housing prices (first cost) and housing starts . Two models of the demand for housing starts were estimated. One model utilized a Houthakker-Taylor (Houthakker and Taylor 1970) dynamic formulation; the other model was formulated using a static equilibrium approach.

The elasticity of demand for housing starts with respect to the first cost of the housing was estimated using data for 18 SMSAs from 1973-1975 as reported by the Bureau of Census, the Bureau of Labor Statistics, and the Bureau of Economic Analysis, F. W. Dodge, the Federal Power Commission, and the American Gas Association. Our results indicate that a 10% increase in first cost of housing is likely to decrease housing starts from 9 to 14%.[2]

Average costs of improvements mandated by the Standards to a $60,000 new house approximately equals $1015 (TSD No. 8, Economic Analysis). Assuming that the average price of a house is approximately $60,000, the Standards, on average, increase the first costs of housing by approximately 2%. Given the elasticity estimates reported above, a 2% increase in housing first costs could result in a decrease in housing starts of 1.8% to 2.8%.

However, since the above results are based on an increase in the first costs of housing and not on life-cycle costs, the 1.8% to 2.8% decrease in housing starts is correctly viewed as a reasonable upper bound of the impacts.

Consumers in localities willing to pay for energy efficiency perceive housing costs to increase by $465 ($1015 - $550) as a result of the Standards. This translates into roughly a 1% increase in the first cost of houses which comply with the Standards. A 1% increase in housing costs, given the elasticity of demand estimates reported above, would result in a 0.9% to 1.4% decrease in housing starts. However, consumers in localities not willing to pay for energy efficiency perceive housing costs to increase by $1015 (the full estimated cost reported above) as a result of the Standards. This denotes the upper bound impact described above.

The discussion of property value impacts considers only short-run impacts. In the long run, we would expect consumers to be willing to pay for the full value of housing that complies with the Standards.

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[1]Throughout the remainder of this discussion housing start impacts will be calculated assuming first cost increases of 2%. This approach provides an estimate of the maximum negative impact of the Standards.

[2]Using the Houthakker-Taylor formulation, the price elasticity approximately equaled -0.9. Using the static formulation, the price elasticity approximately equaled -1.4.

Previous analysis, which is discussed in TSD No. 8, has shown that assuming a 3% real discount rate and a set of rising energy prices, the Standards will actually decrease the life-cycle costs of housing. Thus, in the long run, the perceived cost of housing would be lowered slightly under these assumptions, and housing starts would be expected to increase slightly.

How do government sanctions and incentives affect the impacts? For the purpose of this analysis, suppose that sanctions and incentives can be imposed such 100%, 60% or 20% of new buildings comply with the Standards. Further, suppose that incentives can be granted such that 100%, 50% or 0% of the additional housing cost to consumers due to the Standards is subsidized.

The property value impact analysis indicated that government incentives have potential to substantially mitigate the short run impact of the Standards on housing starts. Suppose a 100% tax credit is available to fully subsidize the estimated $1015 average cost difference between homes built to comply with the Standards and those that are not. In localities where consumers are willing to pay for energy efficiency, a $1015 tax credit would decrease perceived housing costs by approximately $550, or 1%. Given the elasticity of demand estimates presented above, this translates into an increase of housing starts in these localities between 0.9% to 1.4%.

For localities where consumers are not willing to pay for energy efficiency, a $1015 tax credit would completely offset any housing cost increases due to the Standards. Housing starts in these localities would not change.

A 50% tax credit would amount to approximately $500. Adding this credit to the amount, consumers in certain localities indicated they were willing to pay for the improved energy efficiency resulting from the Standards ($550) as it approximately offsets the $1015 cost differential attributable to the Standards. In these localities, housing starts would not be affected by the Standards if a 50% tax credit were available.

In localities where consumers were not willing to pay for energy efficiency, a $500 credit would only partially offset the housing cost increase due to the Standards. In this instance, perceived housing costs would increase by approximately 1% due to the Standards. Given the elasticity of demand estimates reported above, housing starts could decrease in these localities from 0.9% to 1.4% even with a 50% tax credit.

In the long run, the net effect of the Standards and the tax credits would be to decrease the perceived cost of housing. A 100% tax credit would result in approximately a $1000 cost decrease and a 50% tax credit would result in approximately a $500 cost decrease. These cost decreases would lead to a 1.8% to 2.8% and 0.9% to 1.4% increase in housing starts, respectively.

Recall that sanctions can be adopted such that 100%, 60% or 20% of new residential buildings comply with the Standards. The impacts on housing starts explained at the outset of this section implicitly assumed that a 0% tax credit and a 100% penetration rate were associated with the Standards. If 60% of new residential construction complies with the Standards and there are no incentives, there will again be a differential effect on housing starts.

In localities where consumers were willing to pay for improvements in housing energy efficiency, a 60% penetration rate implies a decrease in housing starts of slightly less than 0.9% to 1.4%. In localities where consumers were unwilling to pay for improved energy-efficiency, housing starts would decrease by slightly less than 1.8% to 2.8%, under the 60% penetration rate assumption.

Finally, a 20% penetration rate would further mitigate the impact of the Standards on housing starts. In those localities that evaluate house costs on a life-cycle basis, property values for houses in compliance with the Standards would be expected to increase by the full additional cost of 2%. Housing starts would not be expected to decrease because only 20% of new residential construction is in compliance with the Standards and a sufficient number of consumers are willing to pay the additional 2%. Therefore, the perceived cost of housing would not be increased as a result of the Standards. In localities that tend not to evaluate housing life-cycle costs, the perceived cost of housing would be expected to increase and housing starts to decrease slightly in the short run.

In the long run, one would expect that information on the value of housing energy efficiency would circulate to consumers and the penetration of the Standards would increase as builders respond to consumer demand for improved housing energy efficiency. Thus, the impacts on housing starts would best be described by the long-run scenario (100% penetration rate) discussed above.

With an effective public information program and no tax credits, housing starts would be expected to increase slightly in both the short and long run. With both a public information program and full tax credits, housing starts would increase by as much as 1.8% to 2.8% in both the long and short run.

Finally we consider the impact of invoking sanctions. Two types of sanctions will be considered: (1) the sanction discussed in the Act that would cut off all federally regulated mortgage money to a recalcitrant area, and (2) a cut off of state funds from the Pub. L. 94-385 program.

The percent of residential housing starts using federally regulated mortgage money is at least 66%. The percentage of commercial building controlled by this sanction was not calculated because of data deficiencies. Thus, if this sanction were invoked, it is assumed that at least 66% of residential construction and an unknown percentage of commercial building would be stopped in the recalcitrant area.

The impact on housing starts of cutting off state funds under the Pub. L. 94-385 program would be minimal. It is possible that some state and local building may be halted, but that would represent a small percentage of construction. The reason for the small impact on housing starts is that state receipts from Federal agencies do not greatly affect the consumers of residential and commercial buildings.

The conclusions presented above are subject to the same methodological limitations as those in the previous section. However, it is worth repeating that the negative impacts associated with the Standards will be reduced if prospective homebuyers place more emphasis on life-cycle costs than on first costs.

C.1.5.4 EQUITY IMPACTS OF THE STANDARDS

The equity impact of the Standards on individual consumers will vary directly with their rate of discount for future expenditures (i.e., the rate at which they would be willing to trade present income for future income). In a world of perfect capital markets and unbiased taxes, consumers' discount rates and the cost of capital tend to be equal for all individuals. However, in reality this may not be the case and the Standards will have different impacts on different income groups.

Consumers tend to discount future expenditures based on the time value of money, which is often referred to as the interest rate or discount rate. Simply speaking, income received in the present is worth more to the consumer than the same amount of income received at some future date.

Recent evidence (Hausman 1979) suggests a dramatic inverse relationship between income level and consumers' implied rate of discount. These results were based on data concerning the purchase of air conditioners with various energy efficiency ratings (Hausman 1979). The implied discount rates ranged from 89% for incomes below $6,000 to 5.1% for incomes above $50,000. These results indicate that lower income groups are less inclined to perceive life-cycle savings from energy-conserving improvements because of the heavy discount placed on future income. As a result, lower income groups may not be willing to pay as much for improvements mandated by the Standards as higher income groups. If this is the case, any detrimental impacts of the Standards on property values or housing starts may be felt more dramatically among lower income groups than among higher income groups.

Our results also indicate that some consumers are willing to pay for a significant percentage of the Standards-mandated improvements, which leads us to conclude that some consumers do consider building life-cycle costs, and are therefore likely to see no change or perhaps even a decrease in life-cycle costs due to the Standards. It is not clear, however, whether lending institutions will also see the decrease in

life-cycle costs or whether they will continue to make mortgage decisions on the basis of first costs. If they continue existing procedures, then individuals that fall on the borderline of credit worthiness (typically individuals in lower income groups) are likely to be priced out of the market. It has not yet been reasonably estimated how many people this may affect. However, the Federal government has taken steps to inform lenders about the need to consider energy expenses when mortgages are negotiated. If these steps are effective, then the equity impacts of the Standards can be mitigated.

The impacts just described implicitly assumed a 100% penetration rate and 0% incentives. How will lower penetration rates and incentives affect the equity impacts of the Standards? Generally speaking, incentives can alleviate adverse equity impacts of the Standards. For instance, 50% or 100% tax credits will mitigate the cost differential, for all income groups, between houses that comply with the Standards and houses that do not.

Similarly, if the Standards penetrate 60% or 20% of new homes instead of 100%, lower income groups will again be insulated from adverse impacts. If housing that does not comply with the Standards were available at the same price as if the Standards were not implemented, then lower income groups would be no worse off.

These results are presented with the following caveats. For one, there are reasons to suspect that Hausman's estimates of implied discount rates are overstated. His methods require that consumers be perfectly informed about operating cost differences among home air conditioners. Second, conclusions are reached on home-buying decisions based on research about appliance-buying decisions. Finally, these results on equity impacts are based on sparse data and are therefore preliminary.

C.2 REGIONAL ECONOMICS

The purpose of this section is to report 1) the methodology used to estimate the impact of the Standards on regional earnings and employment, 2) an estimate of the impact of the Standards on regional earnings and employment, and 3) an estimate of the relationship between regional impacts and the implementation components.

C.2.1 REGIONAL ECONOMIC IMPACTS METHODOLOGY

Two key parameters of regional economic activity were examined to estimate the regional economic impacts of the Standards: local earnings, and local employment. Bureau of Economic Analysis (BEA) areas were selected as the unit of analysis. This section presents 1) a brief discussion of data sources and methods used to select the BEA areas analyzed, 2) a numerical example which indicates how the impacts of the

Standards on regional earnings and employment were estimated, and 3) a brief discussion of several key assumptions which determine the major limitations of this analysis.[1]

The Bureau of Economic Analysis (BEA) has defined 173 subareas of the Nation, which function as economic units with basic (export) and non-basic (domestic consumption) sectors. The areas are defined such that the trade pattern between them is related to the comparative advantage of each in producing certain export commodities. Also, each area is, or is nearly, self-sufficient in the production of its services. Each of the areas has at least one urban center and a number of surrounding counties that have economic ties to the urban center. Projections to 2020 of population, employment, personal income, and earnings for 37 industrial sectors are available for each BEA region and the SMSA and non-SMSA portions of each region (U.S. Water Resources Council 1974).

Also available for the BEA regions are estimated gross output and earnings multipliers (U.S. Water Resources Council 1977) that relate the changes in total regional output and earnings to an initial change in final demand for a given industry. The change in total output projected by the multiplier consists of three components:

- direct or primary impact--the initial change in final demand for the sector in question,
- indirect impacts--the changes in interindustry demands that are required to meet the initial demand change, and
- induced impacts--the change in household consumption expenditures that are induced from the changes in household income resulting from the direct and indirect impacts.

A sample of 11 BEA regions was selected for analysis. The 11 regions were selected to achieve wide diversity among a number of characteristics. The characteristics used to determine region selection were those hypothesized to be related to the magnitude and direction of the regional impact of the Standards. These characteristics include total population, population growth rate, regional energy prices, and per capita income. Two suggested characteristics were not available at the BEA region level: unemployment rate and share of minority population. Labor force participation rate[2] and the non-white share of the labor force were used, respectively, as substitutes. The 11 regions selected and their characteristics in various years are shown in Table 4-26.

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[1]The effect of the Standards on regions that produce construction materials used for increasing housing energy efficiency was not analyzed. Regions of the country where energy-efficiency materials production is concentrated are shown in Figure 5.1 thru 5-3. The Standards could result in significant economic impacts in these areas.

[2]The labor force participation rate is the share of the population that is employed.

The regional level impacts of the Standards were determined using the national level primary impacts[1] from the Economic Analysis (DOE 1979b). The value of the change in material inputs for buildings is about $1,000 per $60,000 residential unit and $0.80 per sq. ft. of commercial floor space, both in 1978 dollars. These impacts on final demand are allocated to the BEA regions on the basis of construction forecasts for the regions. A numerical example of how primary impacts and energy savings were determined follows.

A hypothetical BEA area is used for this example. Suppose the residential construction forecast for the hypothetical area called for 10 new units. Consequently, the primary impact of the Standards would be $10,000 (10 x $1,000), which reflects the change in final demand for added material inputs. If the average annual energy savings per residential unit is forecasted to be 10 million Btu, and the value of the energy is $5.0 per million Btu, then the value of the energy saved in the region is $500 per year. These two effects, primary impacts and energy savings, provide the information necessary for estimating the total impact of the program upon the region.

Now assume that construction activity is constant over time in the hypothetical region so that the primary impact of the program on the construction industry will also be constant, say $10,000 per year. Also assume the energy savings will be the same for each addition to the stock of buildings, 100 million Btu per year, but the savings will cumulate over time; so the total savings will be 200 million Btu in the second year, 300 million Btu in the third year, etc. This information is displayed in Table C-15 and shows the distribution of the effects over time.

As indicated in Table C-15, in the initial time period, t_o, when the Standards are implemented, the primary impact is $10,000, i.e., the amount of the addition to the price of the building. For this example, assume that lending institutions require a 20% down payment by purchasers. This means that building purchasers, as a whole, face a reduction in income of $2,000 per year and borrow an additional $8,000 per year from lending institutions. Suppose that building purchasers repay the increased loan with annual payments of about $400 per year over a 30-year period. This represents an additional decrease in income for building owners. Finally, energy savings amount to an increase in income of $500 for building owners and an equal decrease for utilities. This distribution of impacts is important for estimating the total impact of the Standards upon the region.

In the second time period, t_1, the impacts upon building purchasers in that time period is identical to those in t_o. However, purchasers from t_o must make their mortgage payment, and they also experience an energy expenditure savings. These two effects cumulate through time, which shifts the distribution of the negative impacts away from lending

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[1]Primary impacts are the changes in final demand for material inputs that take place as a result of the Standards, e.g., added insulation and glass.

institutions and building purchasers/owners to public utilities. The magnitude of energy savings is dependent upon the fuel prices in the region and is subject to large variation.

The net effects of the program are summarized as follows:

Affected Group	Time Period t_o	t_1	t_2
Building Contractors	+$10,000	+10,000	+10,000
Lending Institutions	-7,600	-7,200	-6,800
Building Purchasers	-1,900	-1,800	-1,700
Public Utilities	-500	-1,000	-1,500

These effects may be referred to as the total primary impacts of the program in any given time period. They represent the initial distribution or first round of effects upon these identified groups. This analysis was carried out for all 11 BEA regions.

After the primary impacts were disaggregated to each of the BEA areas, a system of multipliers specific for each BEA area was applied to the primary impacts. The multipliers provide the total change in output, earnings and employment that result from the initial change in final demand. The multipliers are necessary because the initial change in final demand, i.e., building material inputs, affects interindustry demands and demands for other final goods and services. After applying the respective multiplier to the estimated impacts for each group, the changes in output, earnings and employment are obtained, which provide the total impact of the Standards upon the region.

The impacts associated with application of the strict sanction are also determined in terms of earnings and employment. The assumption is made that all construction activity could be halted if the strict sanction were applied indiscriminately and that the sanction could be applied selectively to affect all construction not complying with the Standards. So, given a penetration rate of 20%, i.e., 20% compliance, it is assumed that the other 80% of construction can be halted by the sanction. The impacts are calculated by reducing the level and resultant value of construction activity affected by the sanction and treating this as the primary impact. This impact is then applied to the multipliers for the construction sector to find the earnings and employment impacts. It is assumed that the other three groups (building purchasers, lending institutions and public utilities) will not be affected to the same extent for the following reasons. First, would-be building purchasers will likely hold their funds for the same building investment when construction activity resumes. Second, lending institutions will probably also hold their funds or lend the monies to other financial institutions outside the area. Third, the income forgone by public utilities for the energy that would otherwise have been consumed is relatively small.

TABLE C-15: EXAMPLE OF PRIMARY IMPACTS OF THE CHANGE IN CONSTRUCTION DUE TO THE STANDARDS

Affected Group	Time Period t_o	t_1	t_2
Capital Cost			
Building Contractors	+$10,000	+$10,000	+$10,000
Lending Institutions	-8,000	-8,000	-8,000
Building Purchasers	-2,000	-2,000	-2,000
Annual Payment			
Lending Institutions	+400	+800	+1,200
Building Owners	-400	-800	-1,200
Energy Savings			
Building Owners	+500	+1,000	+1,500
Public Utilities	-500	-1,000	-1,500

Tax incentives and local costs were considered in this analysis. The tax credit assigned was assumed to be equal to the increased capital cost faced by building purchasers. This is treated as an increase in disposable income that is spent on consumer goods and services. The additional earnings and employment impacts are found by applying the appropriate consumption multipliers to this increase in spending. The cost to local governments of implementing and administering the Standards is determined from the estimate of implementation and administration costs of $0.0003246 per dollar of building permit value. This rate is applied to the value of the construction forecast to determine the total cost faced by the local government. These local government costs are then applied to the appropriate local government multipliers to determine the associated earnings and employment impacts.

Inherent in this analysis are a number of assumptions that may affect the magnitude and significance of the results. First, the construction forecasts and initial primary impacts allocated to the regions are based upon a national average relationship and are, therefore, subject to error. The multipliers used are from the 1967 national input-output table of the U.S. and have been localized to the regions. These multipliers are valid if the industrial mix of the region is constant over time, if production technology is constant, and if trading patterns with other regions are constant. Finally, the estimated impacts were also derived using forecasts of activity for each of the regions. These forecasts are based upon past growth patterns and relationships both within and outside the regions; should these patterns change, the forecasts may be in error.

C.2.2 REGIONAL ECONOMIC IMPACTS

The impacts of the Standards on regional earnings and employment are presented in this section. These impacts are discussed in relation to sanctions and incentives the government could adopt to facilitate the implementation and enforcement of the Standards. For this analysis suppose that sanctions and incentives can be imposed such that 100%, 60% or 20% of new building construction complies with the Standards. Further, suppose that incentives can be granted such that 100% or 0% of any additional cost to the consumer due to the Standards is subsidized (the additional housing first cost is estimated to be 2%).

The impacts of the Standards on earnings and employment for the alternative penetration rates are shown in Table C-16 for 1980, 1985 and 1990. The figures in Table C-16 represent the percent change in earning and employment from their base (non-Standard) level. The type of methodology used makes the percentage change in earnings and employment always equal. Impacts are shown for three penetration rates so that if sanctions were varied to achieve a certain penetration rate, the impacts can be determined. Impacts of the Standards on earnings and employment assuming a 100% tax credit for alternative penetration rates are shown in Table C-17.

TABLE C-16: PERCENT CHANGE IN EARNINGS AND EMPLOYMENT FOR 20%, 60% and 100% PENETRATION RATES ASSUMING NO INCENTIVES

BEA Region	20% Penetration Rate			60% Penetration Rate			100% Penetration Rate		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
14 New York, NY	0.01	0.02	0.02	0.02	0.05	0.07	0.03	0.09	0.12
52 Huntington-Ashland, WV	0	0	0.01	0	0.01	0.04	0	0.02	0.07
60 Indianapolis, IN	0	0	0.01	0	0.02	0.02	0	0.02	0.03
67 Youngstown, OH	-0.01	0	0.01	-0.02	0	0.02	-0.03	0	0.03
97 Fargo-Moorehead, ND	0	0.02	0.02	0	0.05	0.05	0	0.08	0.08
111 Kansas City, MO	0	0	0	0	0.01	0.01	0	0.02	0.02
128 Killeen-Temple, TX	0	0.01	0.01	0	0.04	0.03	0	0.06	0.05
147 Colorado, Springs, CO	0	0	0.01	0	0	0.02	0	0	0.04
156 Yakima, WA	0	0.01	0.01	0	0.04	0.04	0	0.06	0.06
162 Phoenix, AZ	0.01	0.01	0.01	0	0.03	0.04	0.03	0.05	0.06
171 San Francisco, CA	0	0.01	0.01	0.01	0.02	0.02	0.01	0.03	0.04
Average	0	0.01	0.01	0	0.02	0.03	0	0.04	0.05

TABLE C-17: PERCENT CHANGE IN EARNINGS AND EMPLOYMENT FOR 20%, 60% and 100% PENETRATION RATES WITH 100% TAX CREDIT

BEA Region	20% Penetration Rate			60% Penetration Rate			100% Penetration Rate		
	1980	1985	1990	1980	1985	1990	1980	1985	1990
14 New York, NY	0.03	0.03	0.03	0.08	0.09	0.10	0.13	0.15	0.16
52 Huntington-Ashland, WV	0.04	0.03	0.02	0.11	0.08	0.07	0.19	0.14	0.12
60 Indianapolis, IN	0.02	0.02	0.01	0.07	0.05	0.04	0.11	0.09	0.07
67 Youngstown, OH	0.01	0.01	0.01	0.04	0.04	0.03	0.06	0.06	0.05
97 Fargo-Moorehead, ND	0.02	0.02	0.03	0.05	0.10	0.08	0.08	0.08	0.16
111 Kansas City, MO	0.02	0.02	0.01	0.07	0.05	0.04	0.12	0.09	0.07
128 Killeen-Temple, TX	0.02	0.02	0.02	0.07	0.07	0.07	0.12	0.11	0.11
147 Colorado Springs, CO	0.02	0.02	0.01	0.05	0.05	0.02	0.09	0.04	0.04
156 Yakima, WA	0.02	0.02	0.02	0.07	0.07	0.07	0.12	0.12	0.12
162 Phoenix, AR	0.03	0.03	0.02	0.09	0.08	0.07	0.15	0.14	0.11
171 San Francisco, CA	0.03	0.02	0.02	0.08	0.06	0.05	0.13	0.10	0.08
Average	0.02	0.02	0,02	0.07	0.07	0.06	0.12	0.11	0.10

A final point to be examined in this section is the impact of imposing the full sanction on a region. The impacts of the full sanction are calculated assuming that 20% and 60% of new buildings are in compliance with the Standards. Impacts for the 20% and 60% penetration rate are calculated assuming that 20% and 60% of new buildings are in compliance. Table C-18 shows the impacts of the Standards and full sanctions on earnings and employment for the 20% and 60% percent penetration rates.

TABLE C-18: PERCENT REGIONAL CHANGE IN EARNINGS AND EMPLOYMENT BY PENETRATION RATE ASSUMING FULL SANCTIONS AND NO TAX CREDITS

BEA Region	20% Penetration Rate			60% Penetration Rate		
	1980	1985	1990	1980	1985	1990
14 New York, NY	-10.63	-10.62	-10.62	-5.30	-5.27	-5.25
52 Huntington-Ashland, WV	-13.76	-13.76	-13.75	-6.88	-6.87	-6.84
60 Indianapolis, IN	-10.00	-10.00	-9.99	-5.00	-4.99	-4.98
67 Youngstown, OH	-8.17	-8.16	-8.15	-4.10	-4.08	-4.06
97 Fargo-Moorehead, ND	-9.76	-9.74	-9.74	-4.88	-4.83	-4.82
111 Kansas City, MO	-10.64	-10.64	-10.64	-5.32	-5.31	-5.31
128 Killeen-Temple, TX	-10.08	-10.07	-10.07	-5.04	-5.00	-5.01
147 Colorado Springs, CO	-10.00	-10.00	-9.99	-5.00	-5.00	-4.98
156 Yakima, WA	-10.48	-10.47	-10.47	-5.24	-5.20	-5.20
162 Phoenix, AR	-13.11	-13.11	-13.11	-6.54	-6.53	-6.52
171 San Francisco, CA	-10.40	-10.39	-10.39	-5.19	-5.18	-5.18
Average	-10.64	-10.63	-10.63	-5.32	-5.30	-5.29

APPENDIX D: SUMMARIZATION OF EXISTING BASELINE INFORMATION

This appendix is a compilation of tables and figures that summarize information on the existing institutional and socioeconomic environments. Tables and figures on the institutional environment (Tables D-1 through D-4 and Figure D-1) summarize existing programs and the status of state code adoption and enforcement. Tables and figures on the socioeconomic environment (Tables D-5 through D-9 and Figures D-2 through D-4) summarize existing computer models and forecasts of the baseline economics including building material demand, employment, and employment income.

TABLE D-1: FEDERAL FINANCIAL ASSISTANCE PROGRAMS AFFECTED BY MPS OR FmHA BUILDING STANDARDS

Federal Agency	Title of Program	Administering Agency	Expenditures 1978 ($)	OMB No.
Department of Agriculture	Farm Labor Housing Loans and Grants	FmHA	$ 17,750,000	10.405
Department of Agriculture	Low to Moderate Income Housing Loans (Rural Housing Loans-Section 502-Insured)	FmHA	2,691,300,000	10.410
Department of Agriculture	Rural Housing Site Loans (Section 523 and 524 Loans)	FmHA	2,923,000	10.411
Department of Agriculture	Rural Rental Housing Loans	FmHA	675,944,000	10.415
Department of Agriculture	Above Moderate Income Housing Loans (Guaranteed Rural Housing Loans)	FmHA	0	10.429
Department of Housing and Urban Development	Interest Reduction Payments-Rental and Cooperative Housing for Lower Income Families	FHA	617,345,000	14.103
Department of Housing and Urban Development	Interest Reduction-Homes for Lower Income Families	FHA	106,685,000	14.105
Department of Housing and Urban Development	Mortgage Insurance-Construction or Rehabilitation of Condominium Projects	FHA	10,169,000	14.112
Department of Housing and Urban Development	Mortgage Insurance-Development of Sales Type Cooperative Projects	FHA	4,238,000	14.115
Department of Housing and Urban Development	Mortgage Insurance Group Practice Facilities (Title XI)	FHA	0	14.116
Department of Housing and Urban Development	Mortgage Insurance (Homes, Homes for Certified Veterans Homes for Disaster Victims, and Homes in Outlying Areas)	FHA	2,045,302,000	14.117

TABLE D-1: (contd)

Federal Agency	Title of Program	Administering Agency	Expenditures 1978 ($)	OMB No.
Department of Housing and Urban Development	Mortgage Insurance-Homes in Urban Renewal Areas	FHA	320,000	14.122
Department of Housing and Urban Development	Mortgage Insurance-Housing in Older, Declining Areas	FHA	152,978,000	14.123
Department of Housing and Urban Development	Mortgage Insurance-Investor Sponsored Cooperative Housing (213 Investor Sponsor)	FHA	4,238,000	14.124
Department of Housing and Urban Development	Mortgage Insurance-Land Development and New Communities	FHA	10,795,000	14.125
Department of Housing and Urban Development	Mortgage Insurance-Management Type Cooperative Projects	FHA	4,238,000	14.126
Department of Housing and Urban Development	Mortgage Insurance-Hospitals	FHA	285,004,000	14.128
Department of Housing and Urban Development	Mortgage Insurance-Nursing Homes and Intermediate Care Facilities (232)	FHA	114,208,000	14.129
Department of Housing and Urban Development	Mortgage Insurance-Purchase of Sales-Type Cooperative Housing Units (213 Sales)	FHA	4,238,000	14.132
Department of Housing and Urban Development	Mortgage Insurance-Purchase of Units in Condominiums [234(c)]	FHA	76,959,000	14.133
Department of Housing and Urban Development	Mortgage Insurance-Rental Housing (207)	FHA	16,566,000	14.134
Department of Housing and Urban Development	Mortgage Insurance-Rental Housing for Moderate Income Families [221(d)(4)]	FHA	953,414,000	14.135

TABLE D-1: (contd)

Federal Agency	Title of Program	Administering Agency	Expenditures 1978 ($)	OMB No.
Department of Housing and Urban Development	Mortgage Insurance-Rental Housing for Low and Moderate Income Families, Market Interest Rate [221(d)(3) Market Rate]	FHA	953,414,000	14.137
Department of Housing and Urban Development	Mortgage Insurance-Rental Housing for the Elderly (231)	FHA	173,185,000	14.138
Department of Housing and Urban Development	Mortgage Insurance-Rental Housing in Urban Renewal Areas (220 Multifamily)	FHA	67,189,000	14.139
Department of Housing and Urban Development	Mortgage Insurance-Special Credit Risks (237)	FHA	2,374,000	14.140
Department of Housing and Urban Development	Property Improvement Loan Insurance for Improving All Existing Structures and Building of New Nonresidential Structures [Title I, Section 2, Classes 1(a), 1(b), and 2(b)]	FHA	736,107,000	14.142
Department of Housing and Urban Development	Experimental Homes [233 (Homes) Experimental Housing]	FHA	1,280,000	14.152
Department of Housing and Urban Development	Mortgage Insurance-Experimental Projects Other than Housing	FHA	0	14.153
Department of Housing and Urban Development	Mortgage Insurance-Experimental Rental Housing [233 (Multifamily) Experimental Housing]	FHA	0	14.154
Department of Housing and Urban Development	Housing for the Elderly or Handicapped (202)	FHA	749,627,000	14.157
Department of Housing and Urban Development	Single-Family Home Mortgage Coinsurance (Single-Family Coinsurance Program)		62,643,000	14.161

TABLE D-2: STATE BUILDING ENERGY CODES[a]

State	Status of Code				State Role							Comments
	Res.	Comm.	Public	No Code	Training	Monitoring	Approval of Local Programs	Enforcement	Fines	Tech Asst/ Plan Rev Certif.	Advisory	
Alabama			M		Yes	No	---	---	---	---		
Alaska			M									legislation for statewide adoption of model code to be reviewed in 1/80
Arizona				P								code guidelines to be submitted to legislature in 1/80
Arkansas					Yes	Yes	No	No	No	—	Yes	
	M	M	M									applicable in jurisdictions which have building departments
California	M	M	M		Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Colorado					Yes		No	No	—	Yes	Yes	
	M											mandatory where building permits are issued
		M										mandatory in jurisdictions with building codes
			V									state complies, though voluntary
						Yes						nonresidential only
Connecticut	M	M	M		Yes	Yes	None	Yes	No	Yes	—	
Delaware					Yes	—	—	—	—	—		
	M	M	M									1979 legislation provides for adoption of model code thermal standards in jurisdictions which require building permits

TABLE D-2: (contd)

State	Status of Code				State Role							Comments
	Res.	Comm.	Public	No Code	Training	Monitoring	Approval of Local Programs	Enforcement	Fines	Tech Asst/ Plan Rev Certif.	Advisory	
District of Columbia				P								ASHRAE proposed
Florida			M		Yes	(Yes)		No	No	—	Yes	
	M	M										residential buildings smaller than 1500 sq. ft. exempted
Georgia[b]	M	M	M		Yes	No	No	No	No	Yes	—	
Hawaii[c]					Yes	—	—	—	—	—	—	
	M	M										State law requires adoption of code by counties. No statewide code
			V									in practice county codes are followed
Idaho			M		Yes	—	No		No	Yes	—	
								Yes				upon request of localities
Illinois			M									
Indiana	M	M	M		Yes	Yes	Yes	Yes	Yes	Yes	—	
Iowa			M		Yes	No	No	No	Yes	Yes	—	
	M	M										mandatory only for jurisdictions with building codes
Kansas[d]					Yes	No	None	No	Yes	No	No	
	M	M	M									no legislative mandate, enforcement by utilities

TABLE D-2: (contd)

State	Status of Code				State Role							Comments
	Res.	Comm.	Public	No Code	Training	Monitoring	Approval of Local Programs	Enforcement	Fines	Tech Asst/ Plan Rev Certif.	Advisory	
Kentucky				P								Administrative regs. for code have been adopted. Implemtation expected to begin in 1980
Louisiana				NP								Authority to enact standards passed 5/79. No authority as yet to implement
Maine			M									Standards being developed for implementation in 1980; will be voluntary
Maryland[e]			M		Yes	—	No	No	No	—	Yes	
	M	M										legislation reads "mandatory guidelines"; local jurisdictions may exempt classes of buildings.
Massachusetts	M	M	M		Yes	Yes	None		Yes	Yes	—	
								Yes				offers enforcement assistance
Michigan	M	M	M		Yes	(Yes)	Yes	No	Yes	—	Yes	
Minnesota	M	M	M		Yes	Yes	No	No	Yes	—	—	
Mississippi			M		Yes	(Yes)	—		—	—	—	
	V	V										enabling legislation for voluntary local code adoption passed, state specific version of SBCC proposed for local adoption
								Yes				direct enforcement where local authorities have inadequate apparatus
Missouri			M									

TABLE D-2: (contd)

State	Status of Code				State Role							Comments
	Res.	Comm.	Public	No Code	Training	Monitoring	Approval of Local Programs	Enforcement	Fines	Tech Asst/ Plan Rev Certif.	Advisory	
Montana	M	M	M		Yes	Yes	Yes		Yes	---	---	
								Yes				primary enforcement role; locality may petition to enforce
Nebraska				NP								
Nevada	M	M	M		Yes	(Yes)	Yes	No	No	---	Yes	
New Hampshire	M	M	M		Yes	No	---	No	No	Yes	Yes	
New Jersey	M	M	M		Yes	(Yes)	None	No	Yes	---	Yes	
New Mexico	M	M	M		Yes	(Yes)	No		No	---	---	
								Yes				primary enforcement role if local governments do not choose to enforce
New York	M	M	M		Yes	(Yes)	Yes		No	---	---	
								Yes				enforcement if no local BO
North Carolina	M	M	M		Yes	Yes	Yes	No	Yes	---	Yes	
North Dakota			M		Yes	No	Yes	No	No	No	No	
	M	M										honor system with contractors where no inspectors
Ohio	M	M	M		Yes	Yes	Yes		Yes	Yes	Yes	
								Yes				offers enforcement assistance
Oklahoma					Yes	---	No	No	No	---	---	
	V	V	M									adoption of energy portion of model codes is local option, enabling legislation passed

TABLE D-2: (contd)

State	Status of Code				State Role							
	Res.	Comm.	Public	No Code	Training	Monitoring	Approval of Local Programs	Enforcement	Fines	Tech Asst/ Plan Rev Certif.	Advisory	Comments
Oregon	M	M			Yes	Yes	Yes		Yes	---	---	
			M									lighting standards only, no thermal
								Yes				enforcement if locals do not assume responsibility
Pennsylvania				P								
Rhode Island	M	M	M		Yes	Yes	None		No	Yes	Yes	
								Yes				offers enforcement assistance
South Carolina	M	M	M		Yes	---	---	---	---	---	---	
South Dakota	M	M	M		Yes	---	No	No	No	---	Yes	
Tennessee	M	M	M		Yes	No	---	No	---	Yes	---	
Texas			M									
Utah	M	M	M		Yes	No	No	No	No	---	---	
Vermont				NP								
Virginia	M	M	M		Yes		None	No	No	Yes	Yes	
						Yes						informal information gathering; no formal authority
Washington	M		M		---	---	---	---	---	---	Yes	
		P										nonresidential code to be effective 6/80
West Virginia			M									

TABLE D-2: (contd)

State	Status of Code				Training	Monitoring	State Role			Tech Asst/ Plan Rev Certif.	Advisory	Comments
	Res.	Comm.	Public	No Code			Approval of Local Programs	Enforcement	Fines			
Wisconsin	M	M	M		Yes	Yes	Yes		Yes	---	---	
								Yes				enforcement for all bldgs. greater than 25,000 cu. ft. can certify cities for enforcement up to 50,000 cu. ft.
Wyoming[h]			M		Yes					---	---	
												for public buildings greater than 5000 sq. ft; 5 Home Rule cities have adopted Ch. 53 of UBC

[a]U.S. Department of Energy 1979; unless otherwise noted the sources for this table are: National Institute of Building Sciences 1978, 1979a,b; New Mexico Energy Institute 1979.
[b]Keller 1980a
[c]Keller 1980b
[d]Keller 1980c
[e]Keller 1980d
[f]Keller 1980e
[g]Keller 1980f
[h]Keller 1980g

LEGEND

M = Mandatory
V = Voluntary
P = Legislation Pending
NP = No Legislation Pending
--- = No Information
(Yes) = Monitoring Agency exists; procedures not documented

TABLE D-3: SUMMARY OF STATE ASSISTANCE FOR LOCAL CODE ENFORCEMENT

State	No. of Workshops Length (in days)	Cost	No. of Participants	Req. for Cert.?	Manuals Development?	Target Audience: Gov. Officials	Bldg. Code Officials	Design Professionals	Contractors	Code Administration	Bldg. Industry, General	Suppliers, Tradesmen	Other
AL	40	$50K	300			X	X	X	X				
AK	20										X		
AZ		$50K					X	X		X			
AR	16/1				X		X	X	X	X			
CA		0.5-$1M	10-15K	(X)		X	X	X	X	X		X	
CO	8/1				X		X	X					
CT	10	$45.3K	400					X					
DE	2/1						X	X	X	X			
FL	18		600				X						
GA	105					X	X	X	X	X		X	
HI	2	0.7-	25		X		X			X			
ID	9						X			X			
IL	(No training programs.)												
IN	13/2					X	X	X	X				
IA	8	12K					X	X					
KS						X	X	X					
KY		130K					X			X			
LA		(64K)				(X)	(X)						
ME		(25K)					(X)	(X)	(X)				
MD		30K					X	X	X				General Public
MA	8	100-			X		X	X					
MI	8/2	25K	4000				X						General Public
MN	/3			X	X		X	X	X				General Public
MS	5					X	X						
MO		6K				X							
MT	2/1	1K	35			X							
NB	(No training programs.)												
NV	4	5-8K					X	X	(X)				
NH					(X)		X	X					
NJ	/1-2*			X*		X							*College courses req. for KC

TABLE D-3: (contd)

State	No. of Workshops Length (in days)	Cost	No. of Participants	Req. for Cert.?	Manuals Development?	Target Audience: Gov. Officials	Bldg. Code Officials	Design Professionals	Contractors	Code Administration	Bldg. Industry, General	Suppliers, Tradesmen	Other
NM	24	115K		X	X		X	X	X			X	General Public
NY	36	500K	8500										
NC	92/3	300K			X		X						
ND	4	5-6K					X		X				
OH	15		250				X	X	X				
OK	53	85K*				X	X		X				*Thermal & lighting together.
OR							X	X	X		X		
PA	(40)	(200K)											
RI	2*	20K			X		X						*Also college courses.
SC	9												
SD							X	X	X			X	
TN	15/3	20K					X	(X)					
TX	13/2-3	100K					X	X	X				
UT	/4	112K					X	X	X				
VT	(No training programs.)												
VA	141	50K		X			X	(X)					
WA		(40K)											
WV	(No training programs.)												
WI			2000	X			X						
WY	6/1	15K	180				X	X	X	X		X	

o Parentheses indicate proposed costs or coverage.
o "Bldg./code officials" include inspectors and plan reviewers, as well as other enforcement personnel.
o Information for this chart was derived from the 8/1/79 study conducted by the New Mexico Energy Institute, and supplemented with phone calls. See "Conservation Building Code Implementation, Enforcement and Training Practices" (Clearinghouse for Conservation Technology, New Mexico Institute, University of New Mexico, EM 78-S-01-5231).

TABLE D-4: SUMMARY OF STATUS OF STATE ENERGY CODES

States	Status of State Energy Code as of 1979 (1)	Status of State Building Code as of 1979 (2)	% Population in Permit Places—1970 (3)	Value of Building Permits—1976 ($M) (4)	Permit Value of Each State as % of U.S. Total—1976	Average Annual % Population Change—1970-1977 (5)
Alabama[a]	Public only	St. funded/SBC	61	640	1.2	0.9
Alaska	Public only	All/UBC	44	293	0.5	4.1
Arizona	No current auth.	No curr auth.	96	1,132	2.1	3.5
Arkansas	All buildings[b]	No curr auth.	49	324	0.6	1.3
California	All buildings	All/UBC	100	10,045	19.2	1.3
Colorado	Res. & Comm. only[b]	Multi res/UBC	99	985	1.8	2.3
Connecticut	All buildings	All/BBC	99	584	1.1	0.3
Delaware	All buildings	No curr auth.	100	100	0.1	0.8
D. of Columbia	No current auth.		100	141	1.0	-1.3
Florida	All buildings	All/SBC	90	2,421	5.1	3.0
Georgia	All buildings	Vol/SBC	75	964	1.8	1.3
Hawaii	Res. & Comm. Only	No curr auth.	100	383	0.6	2.1
Idaho	Public only	All/UBC	72	322	0.6	2.5
Illinois	State only	No curr auth.	90	2,631	5.8	0.2
Indiana[a]	All buildings	All/UBC	84	1,193	2.2	0.4
Iowa	All buildings[b]	St. only public	73	746	1.4	0.3
Kansas	All buildings[b]	Education/UBC	80	658	1.2	0.5
Kentucky	No current auth.	Adopting BBC	58	524	1.0	1.0
Louisiana	No current auth.	Adopting BBC	62	725	1.3	1.0
Maine	Public only	Adopting BBC	69	152	0.2	1.2
Maryland	All buildings	All/BBC	100	1,082	2.0	0.7
Massachusetts	All buildings	All/BBC	98	826	1.5	0.2
Michigan	All buildings	All/BBC	95	1,863	3.5	0.4
Minnesota	All buildings	All/UBC	89	1,131	2.1	0.6
Mississippi[a]	State only	Public only/SBC	51	259	0.4	1.0
Missouri	State only	State only/BBC	75	913	1.7	0.4
Montana	All buildings	All/UBC	55	176	0.3	1.3
Nebraska	No current auth.	No curr auth.	76	333	0.6	0.7
Nevada	All buildings	State only/UBC	95	546	1.0	3.6
New Hampshire	All buildings	No curr auth.	82	232	0.4	1.9
New Jersey	All buildings	All/BBC	100	1,267	2.4	0.3
New Mexico	All buildings	All/UBC	100	343	0.6	2.2
New York	All buildings	Voluntary	95	1,403	2.6	-.2
North Carolina	All buildings	All/SBC	61	988	1.8	1.1
North Dakota	All buildings	No curr auth.	63	217	0.4	0.8
Ohio	All buildings	All/BBC	90	2,315	3.0	0.1
Oklahoma	Public only	No curr auth.	69	714	1.3	1.3
Oregon	All buildings	All/UBC	88	986	1.8	1.8
Pennsylvania	No current auth.	No curr auth.	89	1,657	2.1	-.05
Rhode Island	All buildings	All/BBC	100	147	0.4	-.2
South Carolina	All buildings	No curr auth.	83	619	1.1	1.4
South Dakota	All buildings	No curr auth.	56	154	0.2	0.5
Tennessee	All buildings	No curr auth.	69	797	1.5	1.2
Texas	Public only	No curr auth.	77	3,644	6.9	1.9
Utah	All buildings	No curr auth.	95	644	1.2	2.5
Vermont	No current auth.	No curr auth.	62	68	0.1	1.1
Virginia	All buildings	All/BBC	99	1,585	3.0	1.4
Washington	Res. and Pub. Only	11/UBC	99	1,706	3.2	1.0
West Virginia	State only	No curr auth.	45	126	0.2	0.9
Wisconsin	All buildings	All/Own code	90	1,316	2.5	0.7
Wyoming	Public Only	No curr auth.	66	138	0.2	2.8

[a]States with no home rule provisions for cities.
[b]All jurisdictions with building codes required to adopt thermal standards

SOURCES:
(1) National Institute of Building Sciences, Energy Conservation Standards for Buildings, Report prepared for H.U.D., March 31, 1978, pp. 5-6.
(2) Center for Building Technology, The National Bureau of Standards, A Preliminary Examination of Building Regulations Adopted by the States and Major Cities, November 1977.
(3) U.S. Department of Commerce, Bureau of the Census, Construction Reports: Housing Authorized by Building Permits, 1977, pp. 364.
(4) U.S. Department of Commerce, Bureau of the Census, Construction Reports: Housing Authorized by Building Permits, 1977, pp. 6-7. Construction Review, December 1977, pp. 35-36.
(5) U.S. Department of Commerce, Statistical Abstract for 1978, September 1978, p. 14.

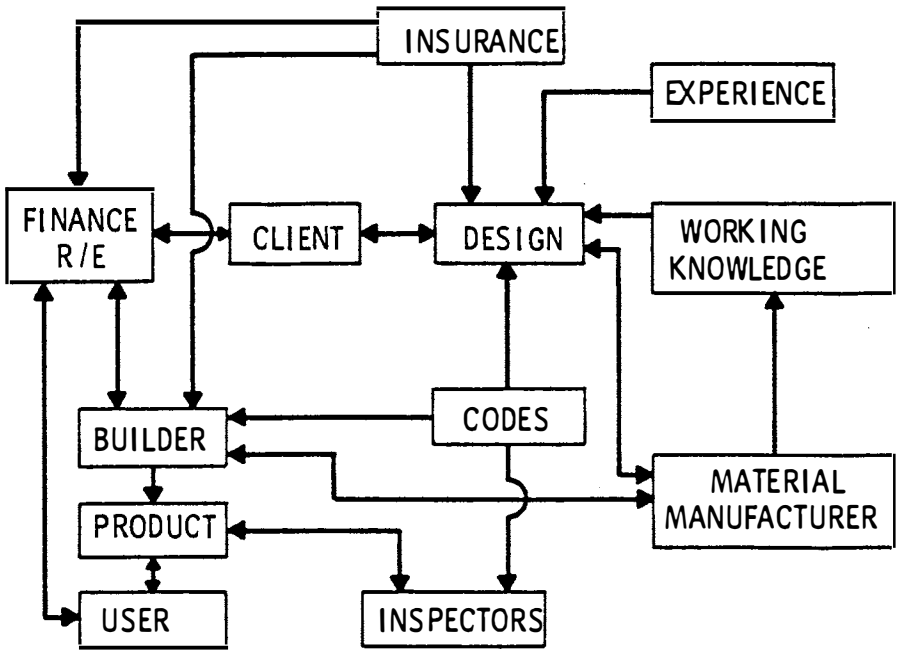

FIGURE D-1: INTERACTIONS WITHIN BUILDING DESIGN PROCESS

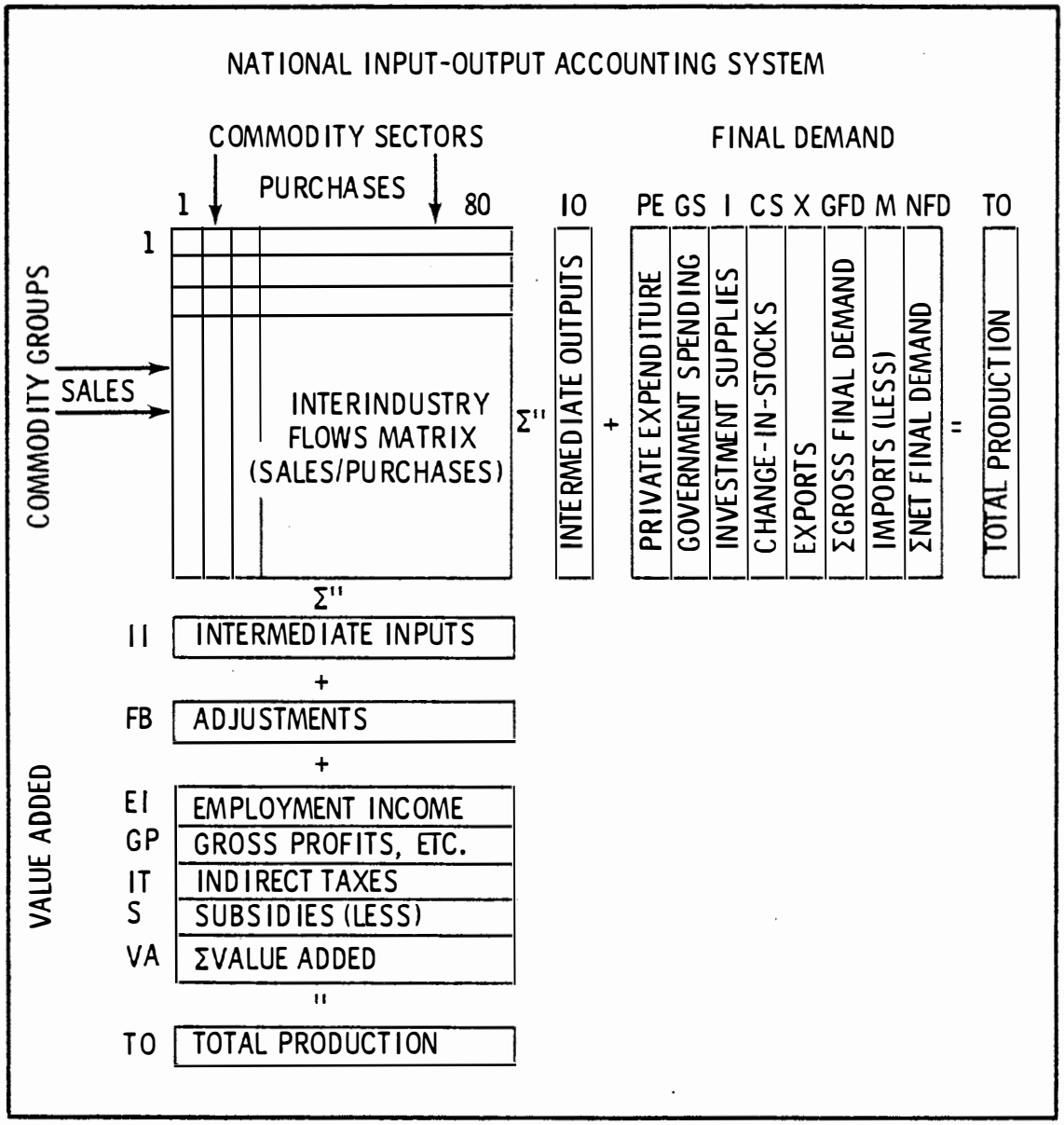

FIGURE D-2: EXPLOR-MULTITRADE ACCOUNTING SYSTEM

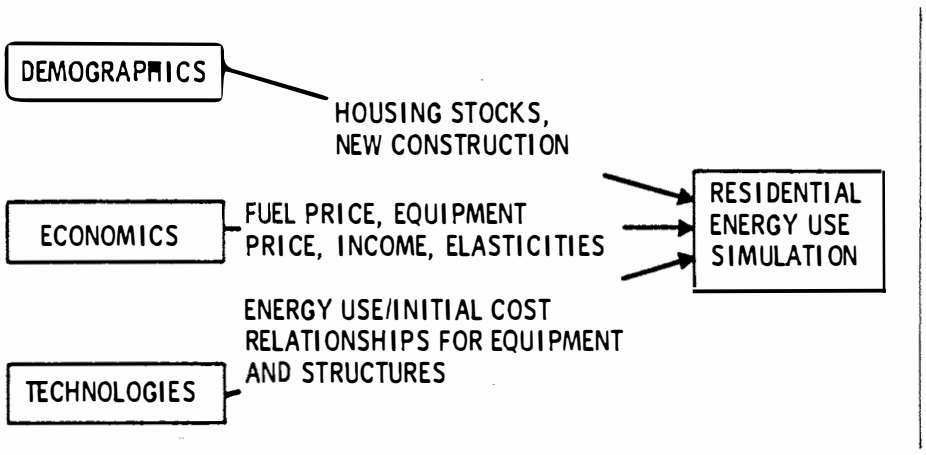

FIGURE D-3: SCHEMATIC OF ORNL RESIDENTIAL ENERGY USE MODEL

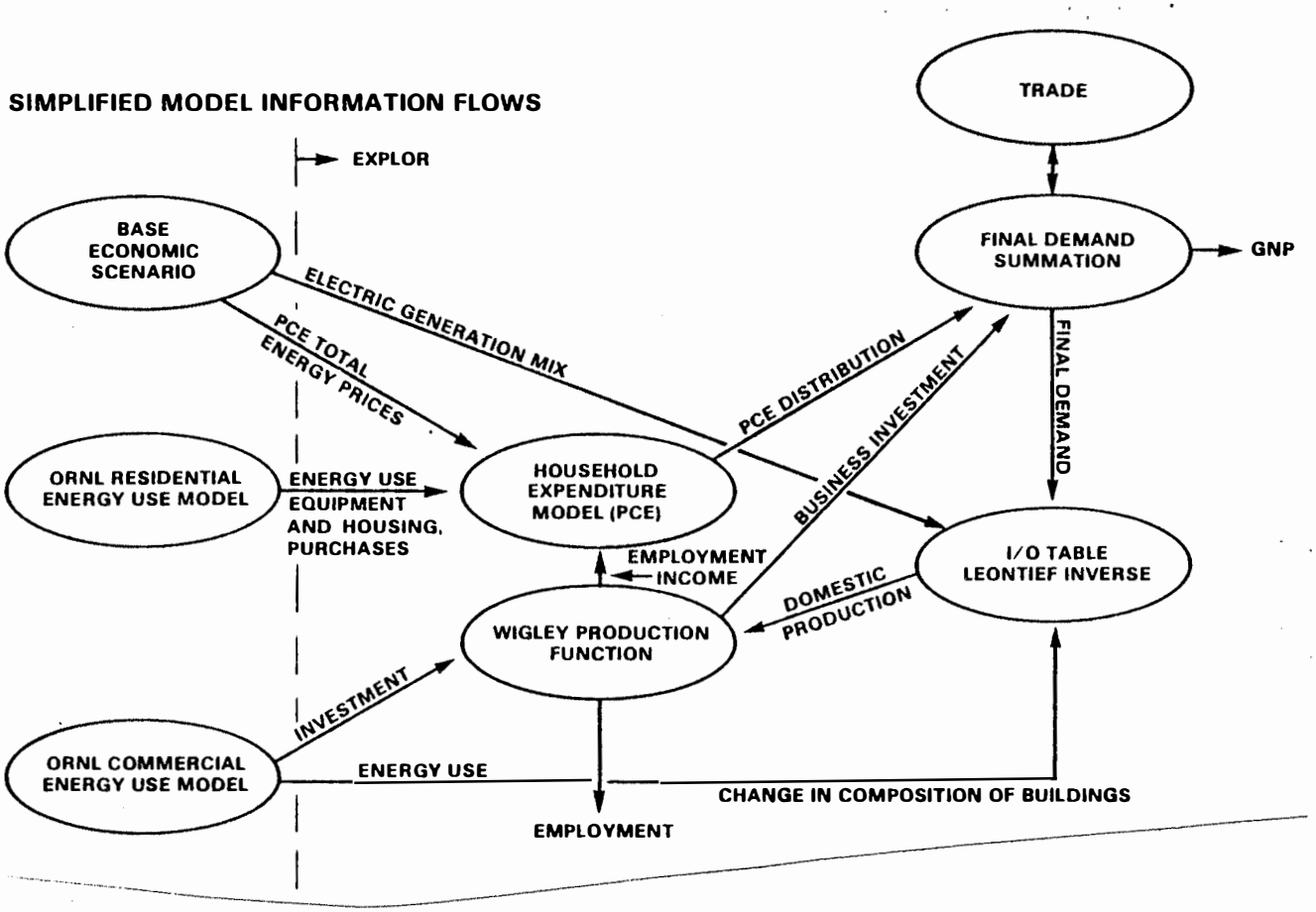

FIGURE D-4: SIMPLIFIED MODEL INFORMATION FLOWS

TABLE D-5: BASELINE FORECASTS FOR RESIDENTIAL, COMMERCIAL AND MOBILE HOMES CONSTRUCTION[a]

	Residential Construction (Thousand Units)						
	Total Residential			ORNL		ADL	
Year	ORNL	ADL	Ratio[b] (ORNL/ADL)	Single-Family	Multi-Family	Single-Family	Multi-Family
1980	2080	1800	1.156	1190	890	1200	600
1990	1800	1790	1.006	1090	710	1235	555
2000	1600	1650	0.970	990	610	1105	545
2020	--	1500	--	--	--	1005	495

	Commercial-Construction (Millions of Sq. Ft.)		
Year	ORNL	ADL	Ratio[b] (ORNL/ADL)
1980	1377	930	1.481
1990	1574	1028	1.531
2000	1993	1197	1.665
2020	--	1585	--

[a]SOURCE: Oak Ridge National Laboratory Energy Use Models and Arthur D. Little, Inc. Study.

[b]These ratios are used to convert ADL's building materials impacts to correspond to ORNL's construction forecasts.

TABLE D-6: BASELINE DEMAND FOR BUILDING MATERIALS[a] (In the Absence of the Standards) (DOE 1979c)

Building Material	1976	1980	1990	2000
Glass Fiber Insulation[b] (Millions of Board Ft.)	25,000	33,000	32,000	32,000
Chemical Insulation Board (Millions of Board Ft.)	1,000	2,400	2,800	3,500
Bricks (Millions of Bricks)	5,700	7,500	7,100	6,900
Plywood Siding (Millions of Sq. Ft.)	890	1,100	1,000	900
Metal Siding (Millions of Sq. Ft.)	500	650	600	570
Concrete Siding (Millions of Sq. Ft.)	70	110	130	170
Masonry and Concrete Block (Millions of Blocks)	160	240	250	290
Flat Glass (Millions of Sq. Ft.)	640	910	830	820
Softwood (Exterior Framing) (Millions of Board Ft.)	1,800	2,100	1,900	1,600

[a]Partial listing of industries affected. These are the only areas which were judged to involve potential environmental impacts.
[b]Includes mobile homes (1,100, 3,700, 3,700, and 3,500 million board ft. for 1976, 1980, 1990 and 2000, respectively.)

TABLE D-7: BASELINE EMPLOYMENT BY SELECTED SECTORS

	1,000 Jobs		
	1980	1985	1990
Electricity	619	647	667
Natural Gas	178	182	172
Building Construction	3,338	3,902	4,068
Electric Appliances	699	838	832
Distributive Trade	20,241	22,035	23,309
Services	45,597	50,723	54,105
Rubber and Plastic Products	825	903	926
Cement	540	593	593
Log and Sawmill Products	406	414	398
Total - All Sectors	106,036	116,249	121,807

SOURCE: BNW EXPLOR Model Base Case for 1980, 1985, and 1990.

TABLE D-8: BASELINE EMPLOYMENT INCOME BY SELECTED SECTORS

	Millions of Current Dollars		
	1980	1985	1990
Electricity	13,969	23,643	33,709
Natural Gas	4,348	7,173	9,362
Building Construction	66,630	125,589	180,645
Electric Appliances	13,575	25,511	34,480
Distributive Trade	254,654	444,896	647,981
Services	507,992	1,131,788	1,811,749
Rubber and Plastic Products	15,326	26,536	37,247
Cement	11,100	19,568	26,961
Log and Sawmill Products	5,610	9,179	11,872
Total - All Sectors	1,508,730	2,879,167	4,275,095

SOURCE: BNW EXPLOR Model Base Case for 1980, 1985, and 1990.

TABLE D-9: BASELINE ECONOMY IN ABSENCE OF THE STANDARDS

BEA Region		Total Earnings (Millions of 1976 Dollars)				% Change Total Earnings		Total Employment (Thousands of Persons)				% Change Total Employment	
		1980	1985	1990	2000	1980-90	1990-2000	1980	1985	1990	2000	1980-90	1990-2000
14	New York, NY	158,271	185,999	128,584	306,688	38.1	40.3	8,954	9,422	9,914	11,122	10.7	12.2
52	Huntington-Ashland, WV	5,914	6,674	7,530	9,782	27.3	29.9	427	426	426	433	-0.4	1.6
60	Indianapolis, IN	12,575	15,073	18,067	25,805	43.7	42.8	829	883	941	1,060	13.5	12.7
67	Youngstown, OH	5,333	6,176	7,151	9,632	34.1	34.7	345	335	366	389	6.1	6.5
97	Fargo-Moorehead, ND	1,552	1,754	1,982	2,610	27.7	31.7	126	125	125	127	-1.4	1.9
111	Kansas City, MO	15,766	18,626	22,004	30,909	39.6	40.5	1,110	1,162	1,216	1,340	9.5	10.1
128	Killeen-Temple, TX	2,113	2,502	2,963	4,132	40.2	39.5	172	179	187	201	8.2	7.8
147	Colorado Springs, CO	2,758	3,265	3,866	5,407	40.2	39.9	211	220	229	249	9.0	8.8
156	Yakima, WA	2,317	2,646	3,020	4,059	30.3	34.4	167	169	170	179	2.0	5.2
162	Pheonix, AZ	10,024	12,405	15,351	22,668	53.1	47.8	673	740	813	945	20.1	16.2
171	San Francisco, CA	43,993	52,551	62,773	89,457	42.7	42.5	2,593	2,768	2,945	3,353	14.0	13.5

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