State of Minnesota
Department of Energy and Economic Development
Energy Division

In the Matter of Proposed
Amendments To Rules Governing
the Home Energy Disclosure
Program and the Mandatory
Energy Efficiency Standards
for Residential Rental Units
6 MCAR § 2.2501-2.2510

STATEMENT OF NEED AND
REASONABLENESS

History

The Department is proposing amendments to the existing rules in order to incorporate several changes that are needed to make them more effective, and to reflect legislative changes to the statute governing the program. These rules govern two separate programs; one establishing an energy audit disclosure at the time of sale for residences, the other establishing minimum mandatory energy efficiency standards for residential rental units.

The original legislation for these two programs was adopted in 1977, and the program was implemented by the Department of Administration. In 1981 the responsibilities for the programs were transferred to the Energy Agency. The Agency proposed administrative rules governing the program on November 16, 1981, adopted temporary rules to implement them immediately in January 1982, and adopted permanent rules on December 13, 1982. Those adopted rules generally were consistent with the ones adopted earlier by the Department of Administration, with the exception of the statutory requirement that the audit be expanded to be consistent with the energy audits provided by major utilities under the National Energy Conservation Policy Act of 1978.

On December 27, 1981 the Energy Division of the Department of Energy, Planning and Development proposed amendments to the Rental Standards component of the rules. Those proposed amendments were based on extensive comments received by the Department regarding the need to improve the standards to make them more meaningful and effective. For instance, one proposed amendment was to require that all walls and attics of rental units be insulated, whether or not they were "accessible" as defined in the existing standards. Research has shown that since the standards were first developed, energy costs have increased significantly enough so that insulating all attics and walls was cost-effective, as defined by the statute creating the program.

The publication of the Notice of Intent to amend the rules in December generated significant interest and the Energy Divison received numerous comments. Many of the suggestions received were well-founded, and the Division took no action to adopt those amendments as published. Those amendments were later withdrawn, and the notice published in the State Register on October 31, 1983.

The second major objective of these rule amendments is to delete all references to the Home Energy Disclosure (HED) Program which was abolished by the 1983 Legislature, Chapter 301, Section 125. The effect of the deletion of rule

references to that program will be to leave intact only those rules referring to the mandatory energy standards for rental housing.

Process

These rule amendments were developed with the assistance of several organizations operating as an informal advisory committee. Drafts of the rules were distributed for review and comment, with significant changes incorporated at each step. In addition several meetings were held with various participants to receive input. Those persons and organizations are:

Jack Horner	Minnesota Multi Housing Association
Tom Warner	Minnesota Multi Housing Association
Steve Swanson	Legal Advocacy Project
Tim Thompson	Southern Minnesota Regional Legal Service, Inc.
Karen Swenson	City of St. Paul
Valdi Stefanson	St. Paul Energy Resource Center
Sheldon Strom	Minneapolis Energy Coordination Office
Chris Copp	Minneapolis Energy Coordination Office
Iric Nathanson	Mineapolis Community Development Agency
Russ Harju	St. Paul Public Housing Agency
Barbara Grossman	St. Paul Public Housing Agency
Murray Casserly	Minnesota Housing Finance Agency
Susan Haugen	Minnesota Housing Finance Agency
Michael Noble	Natural Resources Corporation

Each proposed rule amendment will be cited in bold face, and will indicate the proposed changes from the existing rule through strike outs and underlining. Following each provision, the Department will provide for the need and reasonableness of the change for that section.

5/B J.10 (a) ↑ J.08 (i)

Amendments

6 MCAR § 2.2501 Authority and purpose

A. Authority. The ~~agency's~~ department's authority to adopt these rules is contained in Minn. Stat. § ~~116H.129~~ 116J.27, as well as ~~116H.08~~ 116J.08, clause (a) and ~~116H.07~~ 116J.07, clause (i).

The change in name from "agency" to "Department and the change in the references to the statutory authority is proposed to reflect the merging of the Energy Division into the Department of Energy and Economic Development and the revision of the statutes by the Revisor in 1982.

B. Purpose. The purpose of ~~these rules~~ 6 MCAR §§ 2.2501-2.2510 is to establish a program requiring ~~an energy audit to be performed upon the sale of residential structures. The three major components of this program are the establishment of: minimum energy efficiency standards for the evaluation of existing residences~~ mandatory minimum energy efficiency standards for rental buildings, ~~and~~ procedures for ~~the~~ energy evaluations, ~~disclosure program~~ and the certification of evaluators.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

6 MCAR § 2.2502 Definitions.

A. Scope. For the purposes of 6 MCAR §§ 2.2501-2.2510, the following terms have the meanings given them.

~~A.~~B. Accessible. "Accessible" means:

~~1. For purposes of inspection, any area of the residence which can be evaluated with only the removal of temporary components of the structure. Temporary components include, but are not limited to, electrical plate covers, attic hatch covers and obstructions in closets which provide access to the area of the residence to be evaluated.~~

~~2.~~ for purposes of compliance with 6 MCAR § 2.2503, any area that can be made more energy efficient with the installation of program measures that are not determined to be economically infeasible and which area is exposed, without the removal of permanent parts of the structure.

This section is to be deleted in order to essentially place the same requirements on evaluators as there are on energy auditors in the Minnesota Energy Conservation Service.

G. Economic feasibility. For the purpose of these rules, the test of economic feasibility is met when the savings in energy procurement costs, based on residential energy costs as certified by the commissioner ~~or the director~~ in the State Register, or on local fuel costs, exceed the cost of acquiring and installing each ~~individual program measure~~ standard as amortized over the subsequent ten-year period. The costs of acquiring and installing each standard may include the costs of restoring the building to the condition that existed immediately before the standard was installed, costs to install a vapor barrier where determined necessary, and displacement costs of temporary tenant relocation where determined necessary.

The phrase "or the director" is deleted to reflect that the Energy Agency is now a Division of the Department of Energy and Economic Development.

The phrase "individual program measure" is deleted and the word "standard" inserted to reflect that these rules refer to mandatory standards for rental housing rather than program measures which were evaluated for residences at the time of sale.

The final sentence of this section, which is amended language to the rule, permits additional costs to be incorporated into the determination whether the installation of a particular standard is cost-effective as required by Minn. Stat. 116J.27, Subd. 1. Because the scope of the standards is being broadened to require insulating of all walls, attics, and rim joists in a residential building (not just "accessible" assemblies which is provided for in the current rules) additional costs will be borne by the landlord. The Department has conducted analyses of the costs of insulating these previously defined "inaccessible" assemblies and determined that these improvements are cost-effective as defined by the Statute. The need and reasonableness of each of these will be described in the appropriate section. However, in improving

the energy efficiency of these assemblies, the existing building condition will be marred. For example, holes may be drilled through sheet rock or plaster, or exterior siding removed to install insulation in walls. Thus, an owner must be able to restore the building to its original condition so as not to face a lower-valued building due to compliance with the standards. It is reasonable that unless it is cost effective to install the insulation and restore the assembly to the condition existing immediately before, the owner should not be required to comply with that standard.

In addition, the Department proposes to permit the cost of a vapor barrier, where needed, into the calculation of cost-effectiveness. A major tenet of improving the energy efficiency of a structure is to reduce energy consumption without jeopardizing the structural integrity of the building. Thus, appropriate ventilation is provided for in the insulation of attics (see 6 MCAR § 2.2503 B6) in order to prevent moisture from accumulating, freezing, melting, and rotting the joists. A vapor barrier is routinely required in order to avoid such condensation problems. Again, it is reasonable to install a vapor barrier where one is needed, as determined by the professional judgment of the evaluator, in order to maintain the structural integrity of the building.

Finally the Department proposes to permit, where necessary, the costs to temporarily re-house tenants that might result from installing a standard. Thus, if it is only cost-effective to insulate a wall by blowing insulation into the cavity through holes in the sheetrock, it may be necessary to place the tenant in another unit for a short time. Those costs, necessary to comply with the standards, are reasonable to include in the calculation of cost-effectiveness of the standards.

H. Energy conservation measure. "Energy conservation measure" means ~~any of the following measures in a residential building:~~ energy-saving physical improvements to the building that include but are not limited to modifications to the building structure, heating, ventilating, and air conditioning systems, and lighting that are primarily designed to reduce energy consumption.

This definition is revised to reflect that the term no longer refers to measures recommended by an evaluator of a residence at the time of sale. The term is now defined to include those physical modifications which an owner can make in order to comply with 6 MCAR § 2.2503 B 14 and 15. The definition follows standard industry practice, and describes generally the areas which can be improved that result in energy consumption savings.

I. Caulking. "Caulking" ~~consisting~~ consists of pliable materials used to reduce the passage of air and moisture by filling small gaps located at fixed joints on a building~~, underneath baseboards inside a building, in exterior walls at electric outlets, around pipes and wires entering a building, and around dryer vents and exhaust fans in exterior walls~~. Caulking includes, but is not limited to, materials commonly known as "sealants," "putty," and "glazing compounds."

This definition is revised to delete references to the placement of caulking and limit the section to the definition of the term. The placement of caulking is delineated in the standards at 6 MCAR § 2.2503 B 2 and 13.

~~3. Furnace efficiency modifications consisting of:~~

~~a. A furnace or boiler, including a heat pump, which replaces an existing furnace or boiler of the same fuel type and which reduces the amount of fuel consumed due to an increase in combustion efficiency, improved heat generation, or reduced heat losses.~~

~~b. A furnace replacement burner (oil) which atomizes the fuel oil, mixes it with air, and ignites the fuel-air mixture, and is an integral part of an oil-fire furnace or boiler including the combustion chamber, and uses less oil than the device it replaces.~~

~~c. An automatically operated damper installed in a gas-fired furnace (often called a vent damper) which is installed downstream from the drafthood and conserves energy by substantially reducing the flow of heated air through the chimney when t~~

~~8. Duct insulation consisting of a material primarily designed to resist heat flow which is installed on a heating or cooling duct in an unconditioned area of a building.~~

~~9. Pipe insulation consisting of a material primarily designed to resist heat flow which is installed on a heating, cooling or hot water pipe in an unconditioned area of a building.~~

~~10. Water heater insulation consisting of a material primarily designed to resist heat flow which is suitable for wrapping around the exterior surface of the water heater casing.~~

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

~~13. Heat reflective and heat absorbing window or door material consisting of a window or door glazing material with exceptional heat absorbing or heat-reflecting properties or of reflective or absorptive films and coatings applied to an existing window or door which thereby result in exceptional heat-absorbing or heat-reflecting properties.~~

~~14. Devices associated with electric load management techniques consisting of customer-owned or leased devices that control the maximum kilowatt demand of the residence on an electric utility and which are any of the following:~~

~~a. Part of a radio, ripple or other utility controlled load switching system located on the customer's premises;~~

~~b. Clock-controlled load switching devices;~~

~~c. Interlocks and other load-actuated, load limiting devices; or~~

~~d. Energy storage devices with control systems.~~

~~15. Clock thermostat consisting of a device which is designed to reduce energy consumption by regulating the demand on the heating or cooling system in which it is installed and which uses:~~

~~a. A temperature control device for interior spaces incorporating more than one temperature control level, and~~

~~b. A clock or other automatic mechanism for switching from one control level to another.~~

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

~~M. Program measures. "Program measures" means all energy conservation measures and renewable resource measures included in the minimum energy efficiency standards for existing residences.~~

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

~~P.~~U. Residence. ~~"Residence" means any dwelling used for habitation during all or a portion of the months of December through March, or permanently by one or more persons. For rental buildings,~~ "Residence" means any dwelling let to another used for habitation during all or a portion of the months November through April. A residence ~~may be owned or rented and~~ may be part of a multi-unit building, multi-family dwelling, or multi-purpose building, but "residence" ~~shall~~ does not include buildings such as hotels, hospitals, motels, dormitories, sanitariums, nursing homes, schools and other buildings used for educational purposes, or correctional institutions. Each dwelling unit in a rental building ~~shall be considered as~~ is a residence. A ~~mobile~~ manufactured home as defined in Minn. Stat. § 168.011, subd. 8, ~~shall be~~ is a residence for purposes of these rules.

The phrases deleted in this section referred only to requirements for the Home Energy Disclosure Program which was abolished by 1983 Session Laws Chapter 301.

The phrase "let to another" is added to more clearly define the meaning of a rental unit, which is the only type of structure now encompassed by the rules. The phrase "let to another" is the standard definition describing the relationship between a tenant and a landlord.

~~R. Seasonal efficiency. "Seasonal efficiency" means the calculated efficiency of a heating system based on the estimated peak (tuned-up) steady state efficiency corrected for cycling losses.~~

~~S. South facing. "South facing" means plus or minus 45 degrees of true south.~~

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

6 MCAR § 2.2503 Minimum energy efficiency standards.

A. Compliance. ~~The minimum energy efficiency standards listed in B, shall be applied to residences according to Exhibit 6 MCAR § 2.2503A.-1. Pursuant to Minn. Stat. § 116H.129, subds. 5 and 7, the standards listed under "Disclosure at time of sale" shall only be used to evaluate the energy efficiency of existing residences built prior to January 1, 1976, at the time of sale. Time of sale means the time when a written purchase agreement is executed by the buyer, or, in the absence of a purchase agreement, the time of execution of any document providing for the conveyance of a residence.~~

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

~~Pursuant to~~ under Minn. Stat. § ~~116H.129~~ 116J.27, subds. 1, 2 and 3, all residences constructed prior to January 1, 1976, which are renter occupied during all or a portion of the months of November through April ~~shall have been~~ must be in compliance with ~~standards adopted pursuant to Minn. Stat. § 116H.27, subd. 1 pertaining to caulking and weatherstripping by January 1, 1980,~~ each applicable standard by the date shown in Exhibit 6 MCAR § 2.2503 A.1, unless those standards are determined to be economically infeasible. ~~Effective July 1, 1983, all residences constructed prior to January 1, 1976, which are renter occupied during all or a portion of the months of November through April shall be in compliance with all standards listed under mandatory compliance and not determined to be economically infeasible.~~

In this section, the changes to the references to the statutes have been made to reflect the revision in 1982 of the state statutes.

The phrase "be in compliance with each applicable standard by the date shown in Exhibit 6 MCAR 2.2503 A.1" has been developed to minimize confusion about the applicability of the standards. The existing language refers to the different dates of applicability and is difficult to understand. The revision to the Exhibit will more easily describe what standards apply. The remaining phrases in this paragraph are then unnecessary and are therefore deleted.

Exhibit 6 MCAR § 2.2503 A.-1.
Applicable Energy Efficiency Standards
from 6 MCAR § 2.2503 B.

~~Type of residence~~ ~~Disclosure at time of sale~~ ~~Purpose Mandatory compliance~~

~~Owner occupied~~

~~Single family~~ ~~Standards 1-4, 9-27~~ ~~None~~

~~Mobile home~~ ~~Standards 1-4, 9-27~~ ~~None~~

~~Condominium building, 2-4 dwelling units~~ ~~Standards 1-4, 9-27~~ ~~None~~

~~Condominium~~

Type of building	Date of applicability		
	January 1, 1980	July 1, 1983	July 1, 1985
	Standards	Standards	Standards
Single family	1-2	1-8	1,2, or 13 and 3-12
Mobile home	1-2	1-8	1,2, or 13 and 3-12
2-4 unit building	1-2	1-8	1,2, or 13 and 3-12
5-11 unit building	1-2	1,3,5,6,7,8, and 2 or 13; OR 1,3,15, and 2 or 13	1,3,5,6,7,8,10,11, 12, and 2 or 13; OR 1,3,15, and 2 or 13
12 plus unit building	1-2	1,3,5,6,7,8, and 2 or 13; OR 1,3,14, and 2 or 13	1,3,5,6,7,8,9,10,11 12, and 2 or 13; OR 1,3,14, and 2 or 13

The proposed exhibit shows which energy standards apply to each kind of renter-occupied residence, and the date that each standard is effective.

Under "Types of Residence" five categories of rental housing are specified. These relate to commonly used practices of describing Minnesota's rental housing stock. Minn. Stat. 116J.27, Subd. 1 provides for the authority to establish standards appropriate for major types of rental housing.

The categories of "5-11 unit building" and "12 plus unit building" are used to describe midsize and large multi family buildings. These categories also reflect standard industry practice, and are similar to categories developed in a major research project that reviewed the rental standards in 1981. That report, "A Study of Energy Conservation in

Rental Housing" used the categories of single family, duplex, 3-4 units, 5-9, 10-19, 20-49, and 50+ units[1]. For purposes of these standards, the categories were consolidated into larger groups reflecting the similarities between groups, the relative frequency of each type, the building construction configuration, and feasibility of retrofitting the various building assemblies. The dates of applicability for the various standards are listed across the top of the exhibit. The January 1, 1980 and July 1, 1983 dates are provided specifically for at Minn. Stat. 16J.27, Subd. 3. The July 1, 1985 date has been established to permit owners additional time in order to comply with the modified standards that are now proposed. Minn. Stat. 116J.27, Subd. 3 provides that "Effective July 1, 1983, all residences which are renter occupied during all or a portion of the months November through April shall be in compliance with all applicable energy efficiency standards." (underlining added) Because the Department is provided the authority to establish all applicable standards, it is enabled to adopt new standards that meet the cost-effectiveness criteria provided for in Subd. 1. See Minn. Stat. 116J. 10(a). However, in order to enable owners of multi-family buildings a reasonable opportunity to make the necessary modifications in order to comply, the Department has proposed an effective date 18 months in the future, or July 1, 1985. In accordance with the principle of providing owners a reasonable time period to bring their buildings into compliance, additional requirements have not been included in the July 1, 1983 compliance date column.

The need for and reasonableness of each new or modified standard will be presented under the explanation of that standard.

B. Enumeration. The following ~~shall be~~ are the minimum energy efficiency standards for existing residences constructed prior to January 1, 1976 that are renter occupied. ~~These~~ The following standards shall be used as indicated in Exhibit 6 MCAR § 2.2503 A.-1.

The phrase "that are renter occupied" has been added to clarify that these mandatory standards apply only to buildings which are renter occupied.

6. Install insulation in accessible attics or ceilings to achieve a minimum total "R" value of the insulation of R-19. If there is insufficient space for the installation of the recommended "R" value, then the ~~recommendation by the evaluator shall~~ standard must be based on installing insulation to fill the available space, while providing for appropriate ventilation.

The phrase "or ceilings" has been added to clarify that insulation is required to be installed in either the attic or the ceiling, depending on the type of building construction. For example, insulation could be installed on top of the floor boards in an attic, or underneath those floor boards (between the joists) but immediately above the "ceiling" of the conditioned space below. Therefore, the phrase has been added to

clearly indicate to owners of the requirements to insulate between the conditioned and unconditioned spaces above a residence.

The phrase "recommended by the evaluator" is deleted and the word "standard" added to reflect that these rules no longer apply to recommended actions to an owner of a residence at the time of sale, but are mandatory energy efficiency standards.

The phrase "while providing for appropriate ventilation" has been added to indicate that when complying with these standards, owners should install the insulation according to standard industry practices. In order to ensure that any moisture that escapes from the conditioned space of the building is evaporated, ventilation of this attic or ceiling space is essential. In addition ventilation of this area will prevent the roof from being warmed, resulting in melting of snow on the roof, which can result in roof damage and leaks to the interior.

7. Install insulation in all accessible rim joist areas to achieve minimum total "R" value of the insulation of R-11. If there is insufficient space for the installation of the recommended "R" value then the ~~recommendation by the evaluator shall~~ standard must be based on installing insulation to fill the available space.

The phrase "recommended by the evaluator" is deleted and the word "standard" added to reflect that these rules no longer apply to recommended actions to an owner of a residence at the time of sale, but are mandatory energy efficiency standards.

8. Install insulation in or on accessible walls and floors enclosing conditioned spaces to achieve a minimum total "R" value of the insulation of R-11~~, when there is no insulation in a substantial portion of the exterior walls or floors over an unconditioned space. Accessible walls shall include above grade foundation walls of basements, cellars, or crawl spaces.~~ If there is insufficient space for the installation of the recommended "R" value, then the ~~recommendation by the evaluator shall~~ standard must be based on installing insulation to fill the available space.

The phrase "or on" walls is added to reflect that technology has progressed substantially since the standards were first developed in 1978. The construction industry now has a wide variety of products available that can be applied to the surface of an assembly that can increase its energy efficiency. These products incorporate surface treatments to make the insulation resistent to weather, or deterioration by caretakers or occupants of the building. For example, wall insulation products include a stucco or plaster finish that would resist rain, damage by maintenance equipment such as lawnmowers, or kicking by children. Because these products are widely commercially available, they are included in the standards as a requirement. Because each of the standards is dependent on the 10 year cost-effectiveness

test provided for in the statute, an owner would not be required to install this insulation if it did not have a simple payback of 10 years or less.

The deletion of the phrase providing for installing insulation only when there was none in a substantial portion of the walls is proposed to eliminate confusion. It has always been unclear whether the phrase meant if some percentage of the wall areas (perhaps one or two rooms) were insulated, if the owner would be exempt from requirements to insulate the remaining walls. Or, it could be interpreted that if there were a 3 inch thick wall cavity and 1 inch of wall insulation were present, if the owner would have to insulate the remaining two inches.

By deleting this clause, owners would be required to insulate those accessible wall or floor cavities whether or not some insulation were already present, if it could be installed cost-effectively. If the owner could insulate those remaining assemblies and receive energy cost savings that would result in a payback of less than ten years, then the owner should be required to comply with the standard.

The sentence providing for insulation of above grade foundation walls is proposed for deletion. First, a requirement to insulate this assembly - a major source of heat loss in apartment buildings - is proposed as a new standard at 6 MCAR 2.2503 B.12. The Department is proposing delaying the implementation of this standard to facilitate the development of policies for application of this type of insulation. Several issues need to be resolved regarding the application of foundation insulation near driveways and sidewalks, behind shrubbery, and around gas mains and water pipes. In addition, the current standard is not very effective since it only requires insulation to grade level, and does not differentiate between interior and exterior applications. Those distinctions result in significant differences in energy savings, and must be clarified. The new standard does rectify these issues.

The phrase "recommended by the evaluator" is deleted and the word "standard" added to reflect that these rules no longer apply to recommended actions to an owner of a residence at the time of sale, but are mandatory energy efficiency standards.

~~9. Install insulation in accessible floors over unconditioned spaces and in rim joists to achieve a minimum total "R" value of the insulation of R-19. For slab on grade construction, insulation shall be installed to achieve a minimum total "R" value of the insulation of R-11. If there is insufficient space for the installation of the recommended "R" value, then the recommendation by the evaluator shall be based on installing insulation to fill the available space.~~

9. Modify the existing heating system so that it operates at a minimum steady state efficiency of 75% as demonstrated through a flue gas analysis provided for in 6 MCAR 2.2504 B.4.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The new language in Standard 9 establishes a minimum operating efficiency for heating plants. This standard, to be effective in July, 1985 applies only to 1-4 unit buildings. There is considerable research and information on this size structure due to the implementation of the Minnesota Energy Conservation Service Program (MECS) where major utilities provide energy audits to their residential customers. Those audits generally indicate that the average existing steady state efficiency is approximately 76% for gas systems and 73% for oil heating systems. (Electric systems operate at 100% efficiency, and propane systems are comparable to natural gas). Thus, most 1-4 unit residences heating with gas will already comply with the standard, as will most oil heated structures. For those buildings that do not currently operate at the minimum efficiency requirements, a low cost tune up will generally increase the efficiency of the system 2 or 3%, which in most cases will enable the building to meet the standard.

Research completed recently by the Department of Economic Security found that replacement of the burner mechanism in an oil furnace, at a cost of approximately $500 would increase the efficiency to about 80% and have a payback of about 2 years, well under the 10 years payback provided for in the statute. Because these improvements are cost effective as defined by the statute, it is reasonable to include this standard. Specific examples of the application of this standard is included as a footnote.[2] The establishment of this standard is reasonable since it effectively serves as a minimum standard by eliminating those heating systems that are extremely inefficient. Because the standard is easily implemented, has relatively low costs and results in significant energy savings, it is needed as one component of the minimum standards program. In order to achieve maximum benefits, both the envelope (ie attic, wall, and foundation insulation) and the heating system need to be treated.

~~10. Install ceiling insulation to achieve a minimum total "R" value of the insulation of R 44 when the existing "R" value of the ceiling insulation, excluding construction materials, is R-30 or less. If there is insufficient space for the installation of the recommended "R" value, then the recommendation by the evaluator shall be based on installing insulation to fill the available space, providing for appropriate ventilation.~~

10. Install insulation in all ceilings or attics between conditioned and unconditioned spaces to achieve a minimum total "R" value of the insulation R-38. If there is insufficient space for the installation of the recommended "R" value, the standard must be based on installing insulation to fill the available space, while providing for appropriate ventilation.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The new language in this standard is parallel to standard #6 in requiring insulation in attics and ceilings. There are two major differences. First, insulation is required in all attics and ceilings. The phrase "accessible" has been dropped because it is now cost-effective to insulate most attics, whether or not it was previously possible to do so without the costs of removing a permanent part of the structure. Because energy costs have risen so dramatically since the standards were first proposed, it is now generally cost-effective (as defined by the statute) to insulate the attic or ceiling and repair the building to its condition existing before the insulation was installed.[3]

The second change is to increase the R-value requirement from R-19 to R-38. Again, because energy costs are now so high, it is cost-effective to insulate to the higher R-value. Although there is a diminishing return to insulating a building (ie. adding the first few inches of insulation will save more energy than adding the last few inches) the energy cost savings of insulating an attic to R-38 will result in a 10 year payback or less. Those owners who installed R-19 insulation to comply with the standard #6 which was required in July, 1983 will also be required to add another R-19 to reach the R-38 since that improvement is also generally cost-effective.[4] The selection of R-38 as the minimum R-value was made to coincide with the Energy Code of the State Building Code.

~~11. Install wall foundation insulation to achieve a minimum total "R" value of the insulation of R-11, when there is not insulation in a substantial portion of the exterior walls or foundation walls. If there is insufficient space for the installation of the recommended "R" value, then the recommendation by the evaluator shall be based on installing insulation to fill the available space.~~

11. Install insulation in all rim joist areas to achieve minimum total "R" value of the insulation of R-11. If there is insufficient space for the installation of the recommended "R" value, the standard must be based on installing insulation to fill the available space.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The new language in this section is parallel to that of standard #7, with one modification. That change is to require that insulation be installed in the rim joist cavity regardless whether it is "accessible" or not as defined by the previously adopted standard #7. Instead, compliance with the standard will rely on whether the rim joist can be insulated to R-11 cost-effectively; that is, whether it will have a payback of 10 years or less.[5]

This new standard, which requires insulation in the same area called for in existing standard #7, is needed to make the standards program effective. Because the need for and reasonableness of insulating the rim joist cavity per se has already been established (the existing standard was established in the 1980 rule making), requiring previously inaccessible rim joists to be insulated is an issue of cost-effectiveness. Because this building assembly represents an area of significant heat loss, and it is cost-effective to insulate it, the standard is both needed and reasonable.

~~12. Install insulation to achieve a minimum total "R" value of the insulation of R-5 on all water heaters when the remaining useful life of the heater appears to be three years or greater and space is available around the water heater to install insulation.~~

12. Install insulation in or on all walls and floors that enclose conditioned spaces to achieve a minimum total "R" value of the insulation of R-11. Walls must include foundation walls of basements, cellars, or crawl spaces. Insulation installed on the exterior of the foundation wall must extend down to two feet below grade level. Insulation installed on the interior or in the foundation wall must be installed from the bottom of the rim joist to the foundation slab or floor. If there is insufficient space for the installation of the recommended "R" value, the standard must be based on installing insulation to fill the available space.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The new language in this section is parallel to that of standard number 8 with several modifications.

First, the standard requires insulation of all walls and floors, regardless whether they were previously defined as "accessible" by the existing standard #8. Since standard #8 was adopted, energy prices have increased so that walls and floors can be insulated by removing a permanent part of the structure (such as drilling holes in the siding or plaster) and repairing it, and result in a 10 year payback or less.[6] Because owners can now include those repair costs in the calculation of cost-effectiveness, it is reasonable to require compliance with this standard.

The other modification from the existing standard 8 is a clarification of the requirements for foundation insulation. The existing language of standard 8 required insulation of the above grade foundation wall. Research completed since the adoption of that standard has found that such a requirement was not very effective in reducing heat loss through that building assembly. First, a significant amount of heat is conducted through the foundation through the first two feet below the ground surface. (The first two feet below grade are significantly affected by outdoor air temperatures, while below that level, the ground temperature is generally more stable.) By insulating to two feet below grade, a

significant amount of heat loss is reduced, resulting in considerable energy savings. Although the costs of digging around a foundation increase the overall costs considerally (especially in comparison to insulating only to grade level) the payback is less than 10 years.[7]

The other clarification on foundation insulation requires that if the foundation is insulated on the interior, that the entire foundation wall be insulated down to the slab or floor of the structure. If the wall were only insulated on the interior to grade level (or even to two feet below grade required for exterior insulation) the remainder of that uninsulated wall will function as a heat sink. The uninsulated portion will absorb heat, conduct it through the masonry (behind the insulation) where it will be conducted to the colder ground on the exterior. Thus, insulating only to grade or to two feet below grade is ineffective, and it is necessary, for the standard to be effective, to insulate to the slab on the interior. It is cost-effective to insulate this assembly.[8]

~~13. Install insulation to achieve a minimum total "R" value of the insulation of R-11 on all accessible heating and cooling ducts in unconditioned spaces.~~

13. Caulk, gasket or otherwise seal interior joints between foundation and rim joist, around window and door frames, between wall and ceiling, at joints between wall and trim boards, at cracks on interior surfaces of walls, and at utility penetrations.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The new language in this section calls for caulking of the interior openings of a building envelope, which is parallel to standard #2 which calls for caulking on the exterior openings of a building envelope.

This standard is added to increase the effectiveness of the standards generally in reducing air infiltration through the building envelope, a major source of heat loss for residential structures. Infiltration is also a major cause of drafts within a unit, which reduces comfort levels for tenants.

Although standard #2 calls for exterior caulking, which should reduce infiltration through the building envelope, it is generally impossible to seal every crack on the exterior because there are an infinite number of minute gaps, holes and cracks. However, the interior surfaces of a building generally present far fewer joints and cracks. Interior caulking of trim around windows, doors, and baseboards will significantly reduce infiltration since these areas are the only sources of entry into the conditioned space. Thus, while there is an infinite number of possible entry areas for infiltration on the exterior, there is a very finite number on the interior. As shown in Exihibit 2.2503 A-1, the owner of a rental building is offered the option of either complying

with standard #2 requiring exterior caulking, or with this standard which requires interior caulking. Owners already in compliance with standard #2 will not be required to do additinal caulking. Caulking these interior areas will very effectively reduce infiltration, and is cost-effective.[9]

Another major reason that this standard is needed is to reduce the migration of moist warm air through interior cracks in the envelope. This warm moist air will condense as it meets colder surfaces within the wall cavity, and will cause the insulation and framing members to get wet. The insulating value of the insulation will be reduced, and the wetness may eventually cause the frame to rot. The requirement of this standard, then, will result in cost-effective energy savings, increase comfort levels for tenants, maintain the effectiveness of the insulation, and minimize the possibility of moisture migration and rot. The standard is therefore needed and reasonable.

~~14. Install insulation to achieve a minimum "R" value of the insulation of R-5 on all accessible heating, cooling or hot water pipes in unconditioned spaces.~~

14. Install energy conservation measures that have had or are predicted to have a cumulative energy consumption savings of 25%. These energy conservation measures must be designated in an energy audit conducted by a registered professional engineer or architect or other person determined qualified by the department. The annual energy consumption savings of 25% must be based on verified energy consumption, normalized to the average number of heating degree days reported by the nearest National Oceanographic and Atmospheric Administration recording station, for any heating season from 1973-1974 to the present. The energy audit must indicate whether the building complies with standards 1, 2, or 13 and 3 of 6 MCAR § 2.2503 B. If the building is not in compliance with those standards, the predicted energy consumption savings resulting from the installation of those standards may be included in the 25% cumulative energy consumption savings.

~~15. Install a clock thermostat when the residence has a thermostat on the existing furnace or central air conditioner that is compatible with a clock thermostat.~~

15. Install energy conservation measures that have a cumulative energy consumption savings of 30%. These energy conservation measures must be designated in an energy audit conducted by a registered professional engineer or architect or other person determined qualified by the department. The annual energy consumption savings of 30% must be based on verified energy consumption, normalized to the average number of heating degree days reported by the nearest National Oceanographic and Atmospheric Administration recording station, for any heating season from 1973-1974 to the present. The energy audit must indicate whether the building complies with standards 1, 2, or 13 and 3 of 6 MCAR § 2.2503 B. If the building is not in compliance with those standards, the predicted energy consumption savings resulting from the installation of those standards may be included in the 30% cumulative energy consumption savings.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The new language in this section provides for two new standards which, because they are parallel, are discussed jointly. Standard 14 applies to 5-11 unit buildings, while standard 15 applies to 12+ unit buildings.

These two standards represent a marked departure from the other 13 standards, which are prescriptive in nature. These new performance standards are provided as an option for owners; they can choose to comply with the prescriptive standards as required in Exhibit 6 MCAR 2.2503 A-1, or they can choose to comply by installing energy conservation measures that save 25% or 30%. By providing this option, owners have greater flexibility in complying with the standards, and may be able to do so more cost-effectively than by installing the prescriptive standards.

Because the program establishing the standards has an overall goal of saving energy in rental housing, development of a performance standard is an important mechanism to support cost-effective energy conservation improvements.

The Department has long recognized that there are other improvements to multi-family buildings that may be more cost-effective than compliance with the prescriptive standards. Until now however, there has not been an effective mechanism to incorporate that information into the rental standards requirements. The development of a performance criterion will give credit to landlords who install or have installed other energy conservation measures in their buildings.

Although standards 14 and 15 are presented as performance options, compliance with standards 1, 2, or 13 and 3 is still required. Inclusion of these standards as part of the 25% or 30% savings is required for several reasons.

First, the requirements for standards 1 and 2 or 13 (caulking and weatherstripping) are specifically provided for in Minn. Stat. 116J.27, subd. 3. The Department is mandated to continue to include them in any standards program. Second, the first two standards have been in effect since 1980, so landlords should already be in compliance. Third, calculations by the Department indicate that these standards are among the most cost-effective options available for owners, since the payback is generally two years or less. Fourth, a secondary goal of the standards is to increase the level of comfort for tenants. Requirements for caulking, weatherstripping and storm windows have the greatest impact on infiltration and drafts. Reduction of infiltration then will lead to increased comfort levels for renters. Finally, in most areas where cities have housing maintenance codes, storm windows are mandated as a measure to reduce deterioration of primary windows from the weather. Owners would therefore generally be required to have storm windows anyway. The requirement to comply with the first 3 standards, as one part of the performance standards, is therefore both reasonable and necessary.

The selection of 25% and 30% energy savings for 12+ unit buildings and 5-11 unit buildings respectively is based on the 1980 MHFA study. That analysis calculated the energy savings that would result from different sized buildings complying with the prescriptive standards. Thus, the 25% option is what 12+ unit buildings would have saved if they complied with the prescriptive standards.[10] If owners of these buildings can install other cost-effective, (or more cost-effective) measures, then the goal of the program is also achieved. Similarly, the 30% savings requirement for 5-11 unit buildings is what would have been saved if they complied with the prescriptive standards.[12] These two groupings were established since they are representative of the major types of residential rental housing in Minnesota.

A performance standard was not established for 1-4 unit buildings for several reasons. First, use of a performance standard entails an energy audit by a highly trained technical individual. Owners of these smaller buildings would not likely be able to afford these services. Second, significantly more research has already been conducted on smaller residential buildings that corroborates the cost-effectiveness of installing these prescriptive measures. Finally, because of the limitations of construction practices, there are fewer alternatives for owners to install that save energy as cost-effectively as those measures required in the standards. In contrast, larger buildings can be improved through modifications to the heating distribution system, which is virtually non-existent in small buildings.

In order to determine which energy conservation measures can be installed to meet the 25% or 30% energy consumption savings, the standard requires an energy audit to be conducted by one of three types of professionals. An energy audit by an unbiased individual is the sole method by which an owner can use this optional standard. Reliance on manufacturer's claims of energy savings for particular products, for example, are not sufficiently reliable for a specific installation in a particular building.

The three groups of professionals include Registered Professional Engineers, Architects, and other persons determined qualified by the Department. The first two groups have, as conditions to become certified or registered, requirements for mastery of knowledge in energy conservation. The training requisites for these two groups include studies in thermodynamics, heat transfer principles, and the use of sophisticated evaluation tools.

The Department also proposes to permit other persons, qualified by the Department, to conduct these energy audits. Because energy conservation is a relatively new field, and even more so in terms of multi family housing, there are some individuals who have become experts in this field, but have not met the requirements to become a Professional Engineer or Architect. These individuals are as capable as most Engineers or Architects in providing these energy audits.

A critical element in complying with the 25% and 30% energy consumption savings is the establishment of the base line from which the savings are measured. The proposed rule provides for the use of data from any heating season from 1973-1974 to the present for use as that base. In other words, if a building consumed "x" amount of energy in the 1973-1974 heating season, and the building consumed "x-15%" in the 1981-82 heating season, the owner is given credit for 15% savings. In order to eliminate the effect of either unseasonably warm or cold weather, the rule also provides that the consumption must be normalized. Normalization will convert the consumption of any heating season (either warmer or colder) to a normal season, a standard calculation technique, which will permit comparisons from one heating season to another.

Two types of data are needed to develop this normalized base line consumption. First is the verified fuel consumption records for the building. Copies of utility bills, invoices or other documentation of fuel consumption is mandatory. If this data is not available for a particular heating season, another season must be used as the base year. The other data, heating and cooling degree figures, are routinely available from National Oceonographic and Atmospheric Administration recording stations, which are located throughout the state. These data are often frequently published in local newspapers.

To comply with this standard, if the owner chooses this option over the prescriptive standards, an owner must obtain an energy audit from one of the professional groups already described. The energy audit will develop an energy consumption base line, and compare it to consumption for the most recent year. If the base line consumption is "x", and the consumption for the most recent heating season is x-25% (or x-30% for the 5-11 unit group), and the building complies with standards 1, 2, or 13 and 3, then the building is in compliance with the statutory requirements.

If the most recent heating season consumption is x-10% (meaning that the owner must save an additional 15% [or 20% if it is a 5-11 unit building] in order to comply) then the owner must install one or more energy conservation measures designated in the energy audit to achieve the additional incremental savings. If the building is not in compliance with standards 1, 2, or 13 and 3, the predicted savings from reaching compliance can be included in the 25% or 30% savings.

The Department contends that the availability of this standard as an option to larger multi-family buildings is both needed to achieve optimal cost-effective retrofits to comply with the statutory mandate, and a reasonable method to realize that goal. The flexibility to install other measures recognizes that there are other cost effective energy conservation measures that will save energy just as effectively as the presciptive standards.

15. Install a clock thermostat when the residence has a thermostat on the existing furnace or central air conditioner that is compatible with a clock thermostat.

16. Install a replacement furnace or boiler with a unit of the same fuel type that has a minimum seasonal efficiency of 80 percent, when the existing unit is five years old or older and has a seasonal efficiency of less than 80 percent.

17. Replace the oil burner of an existing furnace or boiler with an oil burner that uses less oil than the device it replaces.

18. Install a vent damper on a gas fired boiler or furnace when the furnace combustion air is taken from a conditioned space.

19. Install an electrical or mechanical ignition system on a gas fired boiler or furnace, when the furance or boiler is located in a conditioned space.

20. Replace all or part of the existing central air conditioner that is five years old or older that has an energy efficiency rating of less than 8.2 with one of the same fuel type to obtain an energy efficiency rating of 8.2 or greater.

21. Install load management devices when the electric utility serving the residence offers a residential rate which reflects any difference in the utility's cost of service between peak and off-peak periods.

22. Install heat reflective or heat absorbing window and door material when the affected rooms of the residence are air conditioned and the cooling degree days for the region exceed 700.

23. Install a solar domestic hot water system when there is a south-facing site that exists on or near the residence that has a prime solar fraction exceeding 0.6.

24. Install a passive solar space heating and cooling system when there is a south-facing site that exists on or near the residence that has a prime solar fraction exceeding 0.7.

25. Install an active solar space heating system when there is a south-facing site that exists on or near the residence that has a prime solar fraction exceeding 0.8.

26. Install a wind energy system when the region's average annual wind speed is equal to or greater than ten miles per hour and there is sufficient unrestricted access to the wind.

27. Install a solar swimming pool heater where a swimming pool is present and it is heated with electricity, gas or another fossil fuel, and the prime solar fraction exceeds 0.8.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

6 MCAR § 2.2504 Conducting the evaluation.

A. Disclosure reports. All evaluators shall use a disclosure report approved by the ~~agency~~ department. Copies of completed disclosure reports must be retained by evaluators for at least five years. The reports must be available for review by the ~~agency~~ department. Copies of audits conducted by registered professional engineers, architects or other persons qualified by the department pursuant to 6 MCAR § 2.2503 B14 and 15 must be submitted to the Department within 14 days for review and approval.

The change from "agency" to "department" is needed to indicate the merger of the Agency into the Department of Energy and Economic Development.

The requirement of Engineers, Architects and other qualified individuals to submit copies of their audits for final review and aproval is needed to assure control by the Department of the standards program. The review of these audits by technical staff will ensure that the audits are thorough, comprehensive, accurate and unbiased. If there is a question, Department staff can arrange to meet the auditor and review the calculations.

~~B. Recommendations. The evaluator shall determine which of the energy conserving practices should save energy in the residence, and in the written report the evaluator shall make a recommendation regarding each practice.~~

~~C.~~B. General duties of evaluators, registered professional engineers, architects, and other approved qualified persons. Evaluators, registered professional engineers, architects, and other approved qualified persons shall estimate energy savings and installation costs of each applicable ~~program measure~~ standard using the calculation procedures in 6 MCAR § 2.2510. An applicable ~~program measure~~ standard is any ~~program measure~~ standard which can be installed in the residence to meet the minimum energy efficiency standards in 6 MCAR § 2.2503. Evaluators, Registered Professional Engineers, Architects, and other approved qualified persons shall:

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The language adding engineers, architects and other qualified persons is needed to ensure that these professionals conduct their audits for compliance with the rental standards in the same way as is done by evaluators. Because the calculation procedures are standard ASHRAE calculations, the industry practice, it is reasonable to require that all audits be done in a uniform fashion.

1. Inspect and take actual measurements of the building shell, and inspect the space heating, space cooling, and water heating equipment; Inspect all

common areas and at a minimum the following number of units for the building being evaluated. The random selecting of units to be included in the representative sample of units inspected shall be done by the evaluator, Registered Professional Engineers, Architects, and other approved qualified persons.

Size of building	Minimum number of units included in inspection sample
1-5 units	all units
5 plus units	5 units + 3% of total number of units in the building

This section has been added to establish a formal mechanism for evaluating and conducting audits of apartment buildings. In order to ensure that the inspection covers the entire building, specific provisions are included to examine common areas and a randomly selected sample of the individual units. Unless a representative inspection is completed, a thorough and accurate evaluation is impossible to develop, and compliance with the standards may be erroneously concluded.

At the same time, it is unnecessary to inspect every unit in a building. The Energy Division has conducted numerous inspections of buildings for compliance with the standards, and found that compliance differs little from unit to unit. Therefore a requirement to inspect only a random sample is reasonable, and needed in order to keep auditing costs as low as possible.

2. Base economic calculations on local fuel prices, or on those prices provided by the ~~agency~~ department, as published in the State Register. ~~each August 1 and February 1.~~

3. Base economic calculations for materials and installation of measures on prices provided by the ~~agency~~ department. Prices must be made available to interested persons ~~evalutors~~ by:

a. Publication in the State Register by the ~~agency~~ department of the most recent contractors and suppliers price survey; or

b. Direct mailing by the ~~agency~~ department of the most recent price survey to certified evaluators~~.~~; or

The deletion of "agency" and addition of "department is needed to reflect the merger of the agency to the Department of Energy and Economic Development.

The deletion of the specific date requirements for publication of fuel prices in the State Register is proposed to enable the Department to provide these prices concurrently with materials and labor costs for installations of measures. This information is available for all

interested persons, not just evaluators, so the clause has been modified to reflect that public availability of this data.

c. if the owner contends that the prices provided by the department are not representative of actual costs that would be incurred by installing the measure to comply with the standards, the owner shall obtain at least three bids from bonafide contractors indicating the costs of installing that measure. The lowest bid must then be used in determining whether the standard is economically infeasible.

This section has been added to permit owners a means of appeal if they believe that the evaluation for compliance does not accurately reflect the circumstances for a particular building. The prices used by evaluators are those provided for at 6 MCAR 2.2504 B3, which the Department develops through a statewide survey of contractors. Those prices are by necessity averages, which cannot account for every possibility in every building. Because those prices are used in the calculation of the payback, if it is less than 10 years the standard must be installed. In some cases, an unusual circumstance might cause an owner to have to pay significantly more than the average price to comply with a standard, causing the actual payback to be longer than that predicted in the audit. To permit the owner an appeal, the owner can obtain 3 bonafide bids, a standard industry practice and present them to the evaluator. That lowest price can be used by the evaluator to recalculate the payback to determine whether the owner needs to comply with that standard. This provision is needed to protect owners from having to install standards that are not cost-effective, and is a reasonable method to permit an alternative way to conduct that calculation.

~~4. Base calculation procedures for active solar domestic hot water and space heating systems on those contained in the HUD Intermediate Minimum Property Standards Supplement. Solar Heating and Domestic Hot Water Systems 4930.2, 1977 Edition; and~~

~~5.~~4. Base any cost and savings estimate for any applicable furnace efficiency modfication to a gas or oil furnace or boiler on an evaluation of the ~~seasonal efficiency or the agency published default table, whichever is higher, of the furnace or boiler. Seasonal efficiency shall be calculated on an estimated peak (tuned-up) steady state efficiency corrected for cycling losses as follows:~~ steady-state efficiency of the heating system.

The original language of this section is deleted since it refers only to the Home Energy Disclosure Program which has been eliminated by the 1983 Legislature.

The language requiring that the efficiency of a heating system be based on the steady-state efficiency has been adopted since it is that figure that is directly derived from a flue gas analysis described in a and b that follow. The steady state efficiency calculation is a common standard in the heating appliance industry.

a. For oil furnaces or boilers, the steady state efficiency shall be derived by a flue gas analysis of the measured flue gas temperature and carbon dioxide content.

b. For gas furnaces or boilers, the steady state efficiency shall be derived from manufacturer's design data. If the manufacturer's design data ~~do not exist,~~ are not available at the time of the inspection, then a flue gas analysis, as described in a. must be performed.

The phrase "do not exist" is replaced by the new language requiring that the data be available to clarify earlier confusion by evaluators. Under the old language, it was possible to argue that the required design data did exist, but it was not available on-site. Without that data, an evaluator cannot make the required determination, so it is reasonable to provide that the data be available at the time of inspection.

~~D. Solar water and space heating systems. Every evaluator assessing solar domestic hot water and active solar space heating systems shall include:~~

~~1. An evaluation containing:~~

~~a. The square foot area of the solar collector;~~

~~b. The solar collector characteristics, including glazing materials and other solar collector materials;~~

~~c. Any storage system needed, including the capacity of storage;~~

~~d. Any freeze protection needed;~~

~~e. The estimated percent of the water heating load to be met by solar energy;~~

~~f. Any physical connections needed with existing heating systems;~~

~~g. The annual maintenance costs;~~

~~h. Any site preparation needed; or~~

~~2. Fact sheets developed by the agency that provide the information in 1. for a typical residence.~~

~~E. Passive solar space heating systems. Every evaluator assessing passive solar space heating systems shall include the following information:~~

~~1. An evaluation which includes:~~

~~a. A general description and an illustration of the system;~~

~~b. The estimated percent of the maximum heating requirements of the residence that could be met by the system;~~

~~c. The approximate dimensions of the system;~~

~~d. The method employed by the system to store heat, including the heat capacity for heat storage; or~~

~~2. Fact sheets developed by the agency that provide the information in 1. for a typical residence.~~

~~F. Wind energy devices. Every evaluator assessing wind energy devices shall include the following information:~~

~~1. An evaluation which includes:~~

~~a. Installation cost estimates, based on the installation costs of a commercially available device with kilowatt ratings appropriate to the level of electricity consumed in the customer's residence;~~

~~b. The evaluator's estimate of the average wind speed at the residence based on data available at the nearest wind measurement station;~~

~~c. The specifications of the device under consideration;~~

~~d. Estimates of energy cost savings, based on average yearly wind speeds and the specification of the selected wind device; or~~

~~2. Fact sheets developed by the agency that provide the information in 1. for a typical residence.~~

~~G. Disclosure. The following disclosure shall be included in any report prepared pursuant to D., E., or F.:~~

~~"The energy cost savings estimates you receive are based on systems which may be somewhat different from the ones you purchase. Also, these estimates were not determined using actual conditions but by using simulated measurements. Therefore, the cost savings we have estimated may be different from the savings which actually occur."~~

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

6 MCAR § 2.2505 Presentation of evaluation and audit results. ~~Upon completion of the evaluation, the evaluator shall provide the following information in writing to the seller or the seller's agent:~~ A copy of the disclosure report or audit shall be provided to the owner or the owner's agent. The disclosure report or audit must, at a minimum, contain the following information:

This section is modified slightly to specify that the written information provided to the owner is a copy of the actual disclosure report or audit. This change is reasonable since it minimizes any confusion about what precisely the owner can expect to receive.

A. An estimate of the total cost for materials and labor of installation by a contractor ~~expressed in a range of dollars, within a range of plus or minus 20 percent~~ of each applicable ~~program measure~~ standard addressed in the evaluation.

The deletions in this section refer to price ranges required under the now eliminated Home Energy Disclosure Program.

~~B. An estimate of the total cost of installation by the owner expressed in a range of dollars, within a range of plus or minus 20 percent, of each applicable program measure addressed in the evaluation; however, the evaluator shall not provide an estimate to an owner of the cost of installation by the owner of replacement central air conditioners, wall insulation, furnace efficiency modifications, devices associated with load management techniques, or wind energy devices.~~

~~C.~~B. An estimate of the savings in energy costs ~~expressed in a range of dollars, within a range of plus or minus 20 percent~~, which would occur during the first year from the installation of each applicable ~~program measure~~ standard addressed by the evaluation.

~~D.~~C. An estimate of the payback period, measured in years, from the energy cost savings of each of the applicable ~~program measures~~ standards installed individually.

~~E.~~D. The following disclosure: "The procedures used to make these estimates are consistent with the ~~Minnesota Energy Agency~~ department's criteria for ~~residential~~ energy ~~audits~~ evaluations. However, the actual installation costs you incur and energy cost savings you realize from installing these ~~measures~~ standards may be somewhat different from the estimates contained in this ~~audit report~~ disclosure report or audit. Although the estimates are based on measurements of your ~~house~~ building, they are also based on assumptions which may not be appropriate for your ~~household~~ building."

The deletions in these sections refer to the now eliminated Home Energy Disclosure Program, while the new language clarifies that the Energy Agency is a Division of the Department of Energy and Economic Development. References to "evaluation" and "measures" are changed to "disclosure report" and "standards" to reflect the elimination of the HED Program.

~~F. Sample calculations of the effect of the federal and state energy tax incentives on the cost to the owner of installing one applicable energy conservation program measure and one applicable renewable resource program measure.~~

E. A listing of the units of the building that were actually inspected, and the date of the inspection, as described in 6 MCAR § 2.2504 B.1.b.

The language deleted in this section refers to the eliminated HED Program. The new language requires listing of the actual units

inspected (required at 6 MCAR 2.2504 B1b). It is reasonable for the owner to receive a listing of the units inspected, and necessary for the record so that the Department can monitor compliance.

~~G. If the evaluation is of rental property, a separate list of those improvements necessary to bring the residence into compliance with Minn. Stat. § 116H.129, subd. 3.~~

F. The name, address, and telephone number of the person who conducted the inspection and who completed the disclosure report or audit.

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The new language is added to ensure that the owners, and any others who review the audit or disclosure report, may be aware who conducted that audit. Such a requirement is essential for monitoring purposes, and to ensure that only approved or qualifed persons provide these reports.

6 MCAR § 2.2506 Prohibitions and exemption.

A. ~~Recommendations and endorsements.~~ Prohibitions. The evaluator, registered professional engineer, architect, or other approved qualified person shall:

1. not recommend ~~or discuss~~ any supplier~~,~~ or contractor ~~or lender~~ to any owner.

2. not endorse the use of specific brand names of materials or products, persons, firms, or contractors which may be used to meet any specific standard.

3. not make any statements relating to the standards which may be interpreted as an endorsement of any specific material or product.

~~B. Exclusion of measures. The evaluator shall~~

4. not exclude any applicable ~~program measures~~ standards in the presentation of the audit to the owner.

~~C. Costs of certain products. The evaluator shall not include in the written evaluation costs or energy cost savings of installing any product which is not defined as a program measure.~~

~~D. Required disclosure. The evaluator shall~~

5. provide the owner with a written statement of any interest which ~~the evaluators~~ he or she or ~~the evaluator's~~ his or her employer has, directly or

indirectly, in the sale or installation of any ~~program~~ energy conservation measure ~~or in the sale of the residence to be evaluated~~; and

6. not conduct an evaluation of a building in which he or she has an ownership interest or is employed (other than to conduct the evaluation) by any person having an ownership interest in the building.

This section is reorganized to make it more understandable for those conducting the audits and evaluations. Language is added to require that the other professionals authorized to conduct audits comply with these minimum standards to remain unbiased in their work. The deleted language refers only to the HED Program which has been eliminated.

The new language refering to the prohibition of ownership interest is needed to prevent conflicts of interest to ensure that the disclosure reports and audits are unbiased.

B. Exemption. If the building is a low rent housing project owned by a public housing agency as defined in Minnesota Statutes, section 462.421, subdivision 12, the energy audit or disclosure report provided for at 6 MCAR § 2.2504 may be provided by an officer, or employee of the agency, if the audit is conducted in accordance with Code of Federal Regulations, title 24, sections 865.301-836.310, if the procedures prescribed in 6 MCAR § 2.2504 are followed, and if the audit includes the standards provided in 6 MCAR § 2.2503. Persons conducting these audits are exempted from the certification requirements of 6 MCAR § 2.2507. However, unless the officer or employee of the agency meets the requirements of 6 MCAR § 2.2503 B.14. or 15., they shall not conduct an energy audit for compliance with 6 MCAR § 2.2503 B.14. or 15.

This exemption for public housing is provided because these public housing agencies are required by federal rule to conduct audits and install certain energy conservation measures. The exemption permits the public housing agencies to use their own staff to do the audits, since they are permitted to do so under the federal rule. Allowing the audit conducted under the federal program (as long as the standard calculation procedures, required measures, and prices are used) will avoid duplication and unnecessary expenditures by these agencies.

6 MCAR § 2.2507 Qualification Procedures for evaluators

B. Training

1. Except as provided in 2. no person ~~shall be~~ is eligible for certification ~~pursuant to~~ under C. unless he or she has first participated in a training course which has been approved by the ~~agency~~ department and which covers the subject matter tested in the evaluator certification examination.

2. The following persons ~~shall be permitted to~~ may take an appropriate ~~agency~~ department approved orientation session, in lieu of the requirements of 1.

e. Members of the American Institute of Real Estate Appraisers, the Society of Real Estate Appraisers, the Independent Fee Appraisers or other asso-

ciations determined by the ~~agency~~ department to have applicable training requirements for their members;

C. Certification

1. All persons must take and pass a certification examination conducted by the ~~agency~~ department. The certification examination must test for the following qualifications:

e. The capability to conduct the ~~HED~~ energy evaluations including: a working knowledge of energy conserving practices, the ability to determine the applicability of each of the program measures, and proficiency in the auditing procedures for each applicable program measure established in 6 MCAR § 2.2504;

~~g. An understanding of the nature of solar energy and its residential applications including: insolation, shading, heat capture and transport, and heat transfer for hot water;~~

~~h. An understanding of the nature of wind energy and its residential applications including: wind availability, effects of construction, wind capture, power generation, and interfaces with residential and utility power lines; and~~

~~i.~~g. A working knowledge of building and fire codes related to the installation and safety of wood burning appliances.

2. All persons shall submit a $50 certification fee to the ~~Minnesota Energy Agency~~ department. However, no certification fee shall be charged for certified municipal building officials who are directly employed by a municipality as defined in Minn. Stat. § 16.84, subd. 3, or for employees of public housing agencies as defined in Minnesota Statutes, section 462.421, subdivision 12; or for employees of private non-profit community-based organizations, when the evaluations are performed as part of the employee's normal job responsibilities.

3. All persons shall provide evidence satisfactory to the ~~agency~~ department of liability and of errors and omissions insurance. The minimum value of protection in each category shall be $50,000, and the insurance shall be of the "occurrence" variety where coverage is based on the date when the evaluation is made. A "claims made" policy with a reporting endorsement of at least five years is also acceptable. Coverage shall not be required for evaluators who are employed by municipal governments or public housing agencies, ~~and~~ who perform evaluations as part of their normal job responsibilities. Certified evaluators who have provided a bond to the state as required by the Building Code Division of the Department of Administration shall not be required to obtain the protection required by this paragraph until that bond expires. ~~Bonds shall not be renewed for the purposes of the HED program.~~ In addition, each insurance policy shall:

D. Certification examination. Examinations shall be conducted by the ~~agency~~ department and offered at the following times:

The deletions in this section refer only to the Home Energy Disclosure Program, eliminated in July 1983 in Chapter 301, 1983 Session Laws.

The new language permitting evaluators of public housing agencies to also be exempted from insurance and certification requirements is added to minimize costs to these agencies as they comply with the standards. Employees of these agencies are generally covered by blanket agency policies similar to municipal employees, so this requirment would be redundant and unreasonable.

1. Prior to the date of certificate expiration, the evaluator shall attend a recertification course, as required by the ~~agency~~ department. Successful completion of this course shall recertify the evaluator for the next year. Evaluators not completing the recertification course prior to the expiration date of their certification shall be recertified by completing the recertification course and sucessfully retaking the certification examination.

2. The recertification course requirements for evaluators shall be eliminated for any particular year if the ~~agency~~ department determines that no changes were made in the ~~HED~~ Program that year. Certification shall then be automatically renewed.

3. Persons registering for recertification shall pay a $25 fee to the Energy Division of the Department.

~~3.~~4. This recertification shall occur annually, for the life of the program.

The word "agency" is changed to Department to reflect the merger of the agency fo the Department of Energy and Economic Development.

B. Training. Certification shall be revoked for any ~~HED~~ evaluator certified before July 1, 1981, who does not successfully complete the appropriate training course required in 6 MCAR § 2.2507 B., and the certification examination required in 6 MCAR § 2.2507 C.1.

E. Wrongful acts. Certification shall be revoked when reasonable evidence indicates an undisclosed conflict of interest, a violation of these rules, unethical practices, or negligent performance of duties as an evaluator. In any of these instances, the ~~agency~~ department will, if requested, provide a review to determine whether the revocation was proper. Such a review shall consist of the following procedures:

1. The evaluator shall make a written request for a review to the ~~agency~~ department.

2. The ~~manager~~ director of the office of conservation ~~division~~ shall determine a time to review the request.

c. ~~Agency~~ Department staff may present written or oral testimony, as well as witnesses.

3. The ~~manager~~ director of the office of conservation ~~division~~ shall make a judgment based on the information presented in the review hearing. That judgment shall be presented in writing to the evaluator within three working days of the review.

F. Failure to report. Certification shall be revoked if the reports required in 6 MCAR § 2.2504 A. are not submitted to the ~~agency~~ department as ~~requested~~ required.

6 MCAR § 2.2510 Calculation procedures. The following procedures shall be the basis for calculating energy savings for ~~program measures~~ each standard.

The changes in this section reflect the merger of the agency into the Department of Energy and Economic Development, and that the rules refer only to mandatory rental standards, not to measures disclosed at the time of sale under the HED Program.

Under failure to report, the rule has been changed to enable the Department to require reports rather than to simply request them. Without that authority, the Department's ability to review and monitor the disclosure reports provided by the evaluators is extremely limited. This change is needed to effectively implement the program.

4. Furnace efficiency modifications

a. Replacement furnaces or boilers

Equation #3 - ~~$E = E_0 (1 - \frac{N_0}{N_1})$~~

$$E = E_0 (1 - \frac{N_0}{N_1})$$

The existing formula is stricken and the new formula added to correct a typographical error in the adoption of the existing rule.

IMPACT ON SMALL BUSINESS

The legislature, in Session Laws 1983, Chapter 188, requires an agency proposing new rules to consider the impact those rules would have on small businesses. Minn. Stat. 14.115 Subd. 1 is amended to define a small business as an entity that is "independently owned and operated, is not dominant in its field, and either employs fewer than 50 full time employees or has gross annual sales of less than $4,000,000." The statute requires the agency to consider methods of reducing the impact of the rule by a variety of methods, including less stringent compliance or reporting requirements, less stringent schedules, simplification of compliance requirements, the establishment of performance standards to replace design standards, or total exemption.

The rules as proposed by the Department will have a dramatic impact on the energy consumption of residential rental housing in Minnesota. The proposals to eliminate the loophole "accessible" from the standards for attic and wall insulation will, for example, require substantially greater number of rental units to be insulated. A 1980 study by the Minnesota Energy Agency found that almost 100% of all walls were considered "inaccessible," and therefore, were exempted from the standard. The Department recognizes that owners of rental property, whether small businesses or not, will face additional costs as they comply with the upgraded standards.

It is the Department's position that the proposed rule amendments are essential to effectively implement legislative intent. With the adoption of Minn. Stat. 116J.27 in 1977, the legislature clearly indicated its belief that meaningful, cost-effective standards be established to overcome the substantial barriers that cause rental housing to be energy inefficient. These proposed rules closely follow that intent by relying on the statutory provision that a standard be required only in those circumstances where the energy cost savings are sufficient to pay for the cost of installing the standard in 10 years or less. Because the Department has followed that legislative criterion, owners of rental housing who install the required standards will realize immediate reductions in fuel consumption, and that those savings will pay for the costs incurred installing the standards.

Although the statute only requires the Department to consider the impact on small businesses, it is apparent to the Agency that data are not available which indicate who owners of rental property are. However, it is the belief of the Department that the vast majority of the landlords whose rental units are covered by the statute would be included under the definition of a small business. Since almost half of Minnesota's rental housing stock is comprised of buildings with 4 units or less, it is likely that most owners would be defined as a small business opertion with 50 or fewer employees, or gross annual sales less than $4 million.

Minn. Stat. 14.115 subdivision 2(a) calls for an agency to consider the establishment of less stringent compliance or reporting requirements for small businesses. As noted earlier, the Department developed the upgraded standards to closely follow legislative direction of only establishing standards which pay back in 10 years or less. These minimum energy efficiency standards are minimums, and are substantially less than what would be required under building codes if the building were to be built now. For example, the recently upgraded Energy Code, effective in January, 1984 requires walls to be insulated to R-19, while these rental standards require insulation of walls to only R-11. The Department was cognizant during the development of these proposed rules that the standards would generally apply to owners who are considered small businesses. In developing the standards, the Department worked very closely with the Minnesota Multi Housing Association, an organization that represents landlords across the state. An energy committee was established, partly to provide on-going input to the Department in establishing meaningful and workable rules. That committee frequently cited issues that would affect the small business owner, and worked with the Department to resolve them.

The proposed rule does not provide for mandatory reporting requirements, so consideration of less stringent provisions for reporting was not necessary.

Subdivision 2(b) calls for less stringent schedules or deadlines for small businesses. The Department recognizes that small business operators may especially have greater needs for time to be able to comply with the new standards. The Department considered establishing the effective date of the new standards to take place on the date of adoption of the rule, since it has been the experience of the Energy Division that landlords tend to wait until the standards become effective (or even later) before taking actions to comply with the rule. However, after lengthy discussions with the Multi Housing Association and

others, the Department proposes in the rule to delay the effective date until July 1985. That delay provides owners, mostly small business, almost 18 months to comply.

In addition, the Department is committing itself to more actively publicize the standards, and to provide technical assistance to owners seeking to comply. In the past, due to extremely limited staffing and resources, the Department has not been as successful as possible in informing owners about the standards.

Subdivision 2(c) requires the consideration of simplification or consolidation of compliance or reporting requirements in any proposed rule. A major focus of the Department in developing the proposed rule was to establish meaningful and relevant standards for the wide variety of rental housing types. The rental housing sector is broadly variant, from small structures of 1-4 units (comprising almost half of the covered units) to large complexes with hundreds of rental units. To ensure that the standards were as relevant as possible, the categories of buildings were expanded from four to five to more accurately mesh with the distinctive energy use pattern of buildings under 12 units and those buildings with more.

Those categories are also more differentiated than under the old rule. For example, requirements for storm doors are deleted for larger buildings when Division analysis indicated that installing them was not generally cost-effective. Similarly, requirements for minimum steady state efficiencies are only provided for small structures since they are less expensively tuned than large heating systems in bigger buildings.

The effect of these two changes is to simplify the standards for any given building. An owner can, by using the chart identified as Exhibit 6 MCAR 2.2503 A-1, immediately know which standards apply to his or her building.

Subdivision 2(d) requires consideration of performance standards in lieu of design or operational standards. The Energy Division has long understood that performance standards are the optimal methodology for the incorporation of energy efficiency levels in buildings. For example, the Energy Code, applicable to new construction, establishes an "energy budget" which permits a designer to make trade-offs between various building components.

Unfortunately, data does not yet exist that would permit the Department to establish a minimum "miles per gallon" equivalent for existing rental buildings. Such a system is highly preferred since it credits owners of buildings who have taken other actions, different from those established in this rule, to conserve energy.

However, the Department has developed, after considerable consultation with the Multi Housing Association, a "quasi performance standard." Standards 14 and 15 explicitly establish performance standards of 25% and 30% energy consumption savings that if achieved by the installation of other energy conservation measures, are equivalent to complying with the prescriptive standards. By establishing these performance standards owners can comply with the rules by installing other measures that may be less expensive, more appropriate, and more cost-effective than those required in the prescriptive standards.

Subdivision 2(e) requires consideration of exemption of small business owners from the rule. As noted earlier, it is the Department's belief that the majority of all rental housing owners in the state would be defined as small business operators, and thus subject to consideration of this statutory provision. However, the legislature established its clear intent that rental housing be made more energy efficient through the adoption of minimum energy efficiency standards. Exempting the majority of those owners of that housing from the standards because they are small businesses would negate that intent. The Department has instead worked in other ways to minimize the impact the rules would have. By delaying the effective date, by establishing standards relevant to the various rental housing types to simplify compliance and by establishing performance standards, the Department has worked diligently to limit the negative impact on all owners of rental housing. Finally, the implementing of these standards will result in substantial reduction in the energy consumption of these buildings, improving cash flows. Unlike other codes, compliance actions with these standards actually pay for themselves and result in net profit increases.

The Department has carefully analyzed each standard to determine that it is cost-effective, that is, as defined by the statute, the installation of the standard would pay for itself in energy cost savings in ten years or less. Below is a summary of the costs and savings of complying with each new standard for three representative rental housing types.

The three typical housing types are:

A. A duplex with average energy consumption of 363.4 mm BTU/year, with an average steady state efficiency of 71% for gas and 70% for oil fired heating systems. In determining the cost-effectiveness of complying with the additional standards, it is assumed that the heating system efficiency has been increased to 75%, as required in Standard #9.

B. A six unit building with average energy consumption, with an average steady state efficiency of 75%.

C. A twenty-six unit building with average energy consumption and an average steady state efficiency of 75%.

The costs and savings for complying with the new standards are:

Standard 9 Minimum steady state efficiency of 75% for heating systems (only for 1-4 unit buildings).

		Costs	Annual Savings
Increase efficiency from 72% to 75%	(gas)	$75	$ 82
	(oil)	$90	$107
Increase efficiency from 70% to 75%	(gas)	$100	$144
	(oil)	$115	$187

Standard 10
Example (a) Increase attic insulation to R-38 in an accessible attic.

Building Type

	Duplex	5 unit	20 unit
Attic area	1425 ft^2	2070 ft^2	5310 ft^2
Steady state efficiency	75%	75%	75%
Existing R-value	R-15	R-15	R-15
Insulation costs	$557	$809	$2076
Annual energy cost savings (gas)	$68	$98	$253
(oil)	$74	$108	$277

Example (b) Install insulation in inaccessible attic from R-15 to R-38. Include repair costs to cut hole in gable end to blow in insulation.

Insulation costs		$584	$849	$2177
Energy cost savings	(gas)	$68	$98	$253
	(oil)	$74	$108	$277

Standard 11 Install insulaton in inaccesible rim joists to R-11. Remove existing ceiling tile, install R-11 batt of insulation and replace tile.

		Duplex	6 unit building	26 unit building
Perimeter length		155 ft.	364 ft.	680 ft.
Insulation cost		$217	$510	$952
Annual Energy Cost Savings	(gas)	$35	$67	$170
	(oil)	$38	$73	$185

Standard 12

Example (a) Insulate inaccessible above grade exterior walls. The existing wall has insulation with an R-value of 3.5. The heating system efficiency is 75%.

		Duplex	6 unit building	26 unit building
Wall construction type		wood siding	wood siding	stucco siding
Average wall area		1202 ft^2	2547 ft^2	10,376 ft^2
Cost to insulate		$901	$1910	$11,414
Energy Cost Savings	(gas)	$133	$282	$1,147
	(oil)	$145	$307	$1,251

Example (b) Insulate interior foundation walls to R-11.

	Duplex	6 unit building	26 unit building
Wall area above grade	310 ft^2	728 ft^2	1040 ft^2
below grade	1085 ft^2	910 ft^2	1760 ft^2
Cost to insulate	$2302	$2702	$4620
Energy cost savings (gas)	$1357	$1683	$2827
(oil)	$1466	$1824	$3062

Standard 13 Caulk interior cracks

Estimated length of cracks (feet)

Area	Duplex	6 unit building	26 unit building
Foundation/rim joist	155	182	0 (masonry)
Window frames	212	686	2222
Door frames	68	34	34
Wall and baseboard	310	546	1360
Other cracks	20	60	260
Utility penetrations	3	3	3
Total crack length	768	1329	3879

Assume ½ of crack length is 1/32" wide and ½ of crack length is 1/16" wide.

Cost to caulk		$499	$864	$2521
Annual energy cost savings	(gas)	$267	$462	$1349
	(oil)	$299	$517	$1507

Standard 14 Install energy conservation measures that reduce energy consumption by 25%.

Assume:
Building type: 26 units
Heating system: Gas designed hot water heat

1973-74 annual space heating use = 23,418 therms
1973-74 space heating cost at 1983 prices = $13,255
25% of 1973-74 space heating = $3,314
75% of 1973-74 space heating = $9,941
1982-83 space heating costs = $12,725

Measure	Cost to install	Estimated % savings	Revised space heating costs
12 Thermostatic valves	$660	2%	$12,471
Outdoor reset	$450	20%	$ 9,976
Boiler tuneup	$160	4%	$9,577

Savings from installation of these 3 measures exceeds 25% of consumption.

Standard 15 Install energy conservation measures that reduce consumption by 30%.

Assume:
Building type: 6 units
Heating system: Oil fired hot water with a steady state efficiency of 70%.
1973-74 space heating consumption = 5,810 therms
Energy costs at 1983 fuel cost = $3,281
30% of fuel costs = $984
70% of fuel costs = $2,297
1982-83 heating cost = $3,150

Measure	Cost to install	Estimated $ savings or % savings	Revised space heating costs
Interior caulk	$864	$517	$2,633
Flame retention burner	$500	14%	$2,264

The installation of these 2 measures reduced consumption to below 70% of the original consumption levels, so that at least a 30% reduction is achieved.

Summary

By providing these examples of costs and savings of complying with the standards for 3 different representative building types, it is hoped that rental property owners will have an idea what the costs and benefits of complying with the standards are. While it is impossible to describe every circumstance for every building type, these examples provide a sample for small business owners of the costs of these rules. It is important to note that the energy savings that result are significant, and will result in improved cash flow in a fairly short time.

FOOTNOTES

[1]A Study of Energy Conservation in Rental Housing, Riter, Suppes, Plautz - Architects Ltd. Minnesota Housing Finance Agency, Jaunary 1979. p. D.8.

[2]Standard 9 requires that owners of renter occupied residential buildings "modify the existing heating system so that it operates at a minimum steady state efficiency of 75% as demonstrated through a flue gas analysis."

Since a tune up of the heating system can improve the stedy state efficiency 2-3%, then a 4% energy savings can be achieved by increasing the efficiency of a heating system from 72% to 75%. (As indicated in 6 MCAR § 2.2510 the energy savings resulting from improvement in furnace efficiency may be calculated using equation #3: $\Delta E = E_h (1 - \frac{N_0}{N_1})$. The % savings in energy would, therefore, be calculated:

$$\% \text{ savings} = (1 - \frac{N_0}{N_1}) \times 100)$$

A spot check of a few local heating contractors indicates that a tune up of the heating system can generally be accomplished for approximately $75 for gas heating systems and $90 for oil heating systems.

The total energy savings for a specific building due to an increase in steady state efficiency depends on the size of the original heating bill. If the sample of weatherized houses studied by Bakke, Kapp, Ballow and McFarlin under contract with the Department of Economic Security is representative of one to four unit buildings in Minnesota, annual heating energy use may range from 50 to 450 million BTU, and average around 150 million BTU. Energy savings due to efficiency improvements then, may range from 2 to 18 million BTU per year.

The simple payback for this improvement in these types of buildings for gas and oil heating are shown in the table below. The three types of buildings are low energy users (50 million BTU/year), average energy users (150 million BTU/year), and high energy users (450 million BTU/year).

Table 1 Simple Payback for Heating system efficiency improvements (in years)

	50×10^6 BTU	150×10^6 BTU	450×10^6 BTU
Oil fired system (72% to 75%)	5.9	2.0	.7
Gas fired system (72% to 75%)	6.8	2.3	.8

The simple payback (SPB) is calculated using the following equation:

$$SPB = \frac{C}{\Delta E x F}$$ equation #a

where:

SPB = The simple payback.
C = The cost of the retrofit measure.
ΔE = The quantity of annual energy savings in appropriate energy units such as hundreds of cubic feet of natural gas, gallons of fuel oil or millions of BTU.
F = The cost per unit of fuel. For this example a cost of $5.66 per million BTU of gas and $7.36 per million BTU of oil were used.

As shown in Table 1, the simple payback for improving the steady state efficiency of a heating system may range from 6.8 years for a building with a 50 million BTU/year average heating load and heated with a gas fired heating system to .7 years for a building with a 450 million BTU/year heating load and heated with an oil fired heating system.

The impact of this standard will be greatest in buildings with high heating energy use such as older, larger 4-plex buildings with high infiltration rates or poorly balanced heating systems.

[3]Standard 10 requires that owners of rental property install insulation in all ceilings or attics between conditioned and unconditioned spaces to achieve a minimum total "R" value of insulation of R-38. If there is insuffiicient space for the installation of the recommended "R" value, the standard must be based on installing insulation to fill the available space while providing for appropriate ventilation."

Several factors influence the cost-effectiveness of adding attic insulation. These include the existing level of insulation, the cost of adding insulation, the cost of the fuel saved, and the seasonal efficiency of the heating system. The energy saving impact of adding insulation decreases with each inch of added insulation; that is, the first six inches of insulation saves more energy than

the next six inches. Since the efficiency of the heating system determines the amount of energy which needs to be supplied in order to satisfy a given demand, the efficiency of the heating system will influence the total energy savings resulting from added insulation. The cost of achieving a given "R" value varies depending on the insulating technique used. Also the cost of a given quantity of energy depends on the type of fuel used to supply that energy. These costs, in turn, influence the cost-effectiveness of installing insulation in ceilings or attics.

The impact of various levels of seasonal efficiency and costs of fuels may be combined in a factor called the Heating Cost Factor (HCF):

$$HCF = \frac{D \times 20.4 \times F \times TCF}{N \times V} \qquad \text{equation \#b}$$

where:

HCF = The Heating Cost Factor.
D = The heating degree days (8159 heating degree days are used for this example).
F = The cost per unit of fuel ($5.66 per million BTU for gas and $7.36 per million BTU for oil).
TCF = The factor showing deviation from normally assumed indoor temperature. (For this example no deviation from normal is assumed, therefore TCF = 1).
N = The seasonal efficiency of the furnace.
V = The heating value of a unit of fuel.

Four levels of Heating Cost Factors are considered in this example. A lowest HCF case, highest HCF case and two cases which include heating systems which meet standard 9 with a steady state efficiency of 75% for gas and oil fired systems. These heating cost factors are listed below including the assumed description of the system. (SS refers to steady state efficiency while SE refers to seasonal efficiency of the heating system.)

HCF	SS	SE	Fuel	System Characteristics
1.3	80	72	gas	furnace or boiler with vent damper and intermittent ignition device
1.65	75	57	gas	furnace or boiler with no vent damper or intermittent ignition device
1.80	75	68	oil	furnace or boiler
2.08	65	59	oil	furnace or boiler

Insulating inaccessible attics is more expensive than insulating accessible attics. Inaccessible attics may be insulated by cutting a hole in the gable ends

of the attic walls in a sloped roof assembly or cutting holes in the fascia or sides of roof access route in a flat roof assembly and blowing insulation into the attic space. The cost of cutting a hole in the gable and fascia or roof access is estimated to be about $.017 per square foot of attic space. This is an approximate cost since the size of the attic space which can be accessed with one hole depends on the dimensions and design of the attic. Adding insulation by this method cost $.017/ft^2 for the holes plus $.017/ft^2 R for the insulation.

Inaccessible attics are almost always cost-effective to insulate to R-38. The simple payback periods for various levels of existing insulation and for various heating cost factors are shown below.

Simple payback in years for insulating inaccessible attic spaces

Existing insulation R-value	Cost per square foot	HCF=	1.3	1.65	1.80	2.08
0	$.66		2.3	1.8	1.6	1.4
11	$.48		7.6	6.0	5.5	4.8
15	$.41		10.8	8.5	7.8	6.8
19	$.34		13.1	10.3	9.4	8.2

The simple payback is calculated using the following equation:

$$SPB = \frac{C}{\Delta H \times HCF}$$

Where C = cost of installing conservation measure
ΔH = the difference in design heat loss per degree Fahrenheit between the improved condition and the existing condition. (See MCAR6 2.2510)

This equation is derived from equation #a in footnote #2 as follows:

$$SPB = \frac{C}{\Delta E \times F} \qquad \text{equation \#a}$$

As indicated in 6 MCAR 2.2510, equation 3

$$\Delta E = \frac{\Delta H \times D \times 20.4}{N \times V} \qquad \text{equation \#3}$$

Substituting this in equation #C

$$SPB = \frac{C \times N \times V}{\Delta H \times D \times 20.4 \times F} \qquad \text{eqiatopm \#d}$$

Equation d may also be written:

$$SPB = \frac{C}{\Delta H} \times \frac{N \times V}{D \times 20.4 \times F} \qquad \text{equation \#c}$$

From equation #2 in footnote #3

$$HCF = \frac{D \times 20.4 \times F \times TCF}{N \times V} \qquad \text{equation \#b}$$

Rearranging the terms, equation b may also be written:

$$\frac{N \times V}{D \times 20.4 \times F} = \frac{TCF}{HCF} \qquad \text{equation \#f}$$

Substituting in equation e,

$$SPB = \frac{C}{\Delta H} \times \frac{TCF}{HCF} \qquad \text{equation \#g}$$

For this example it is assumed that temperature settings are average and the temperature correction factor equals one. Thus equation g may be written:

$$SPB = \frac{C}{\Delta H \times HCF}$$

In this case, ΔH is calculated using Equation #9 in MCAR 6 2.2510. For example, the simple payback for adding insulation to bring the insulation level up from an existing level of R-15 to R-38 in a building heated with gas and a 75% steady state efficiency furnace with no vent damper or intermittent ignition may be calculated as follows:

$$\Delta H = \left(\frac{1}{R_0} - \frac{1}{R_1}\right) \times A \qquad \text{equation 9}$$

Where:

R_0 = the total R-value of existing insulation and existing construction materials in present condition. (For a building with R-15 insulation, the total R-value including construction materials is R-19.)

R_1 = total R-value of proposed condition to include total recommended R-value of insulation and construction materials. (Including the construction materials, and the insulation, the total R-value for this example is R-42.)

A = area for which additional insulation is being proposed. (Since each square foot of roof which is insulated will provide the same energy savings, the simple payback is calculated for one square foot.)

Thus,

$$\Delta H = \left(\frac{1}{19} - \frac{1}{42}\right) \times 1 = .029$$

Since,

C = \$ .34/ft^2
HCF = 1.65

The simple payback for this conservation measure is:

$$SPB = \frac{.34}{(.029)\ (1.65)} = 7.1 \text{ years}$$

The removal of the word "accessible" from the standards will ensure that most attic spaces will be insulated to R-38.

[4]Standard 10 requires that owners of rental property install insulation in all ceilings or attics between conditioned and unconditioned spaces to achieve a minimum total "R value of insulation of R-38."

Increasing the required R-value in attics or ceilings from R-19 to R-38 means that almost all accessible attics will be required to be insulated to this level. (See footnote #3 for a discussion of inaccessible attics.) The simple payback periods for insulating accessible attics to R-38 for various levels of existing insulation and heat cost factors are shown below:

Simple payback periods for insulating accessible attics to R-38 (in years)

Existing level of insulation	HCF = 1.3	1.65	1.80	2.08
0	2.3	1.8	1.6	1.5
11	8.2	6.5	5.9	5.3
15	9.4	7.4	6.8	6.1
19	12.4	9.8	9.0	8.1

The simple payback periods are calculated using the procedure outlined in footnote 3.

For example, in a building with an existing level of insulation in an accessible attic of R-11 and which is heated with a gas-fired furnace with a steady state efficiency of 75% and no vent damper or intermittent ignition. (i.e. HCF = 1.65) the simple payback may be calculated as follows:

R_0 = R-15 (The construction materials provide an R-4 and the insulation provides R-11)
R_1 = R-42 (R-38 for insulation plus R-4 for the construction materials.)
A = 1 square foot

$\Delta R = 38 - 11 = 27$
$C = \$.017/\text{sq. ft./R} \times R\text{-}27 = \$.46/\text{sq.ft.}$
$HCF = 1.65$ (See note 3.)

$$SPB = \frac{.46}{(.043)\ (1.65)} = 6.5 \text{ years}$$

[5]Standard 11 requires that owners of residential rental property "install insulation in all rim joist areas to achieve a minimum total "R" value of the insulation of R-11. If there is insufficient space for the installation of the recommended "R" value, the standard must be based on installing insulation to fill the available space."

The factors which influence the cost effectiveness of this measure are the existing level of insulation, whether the rim joist is accessible or inaccessible (i.e. the cost of insulating), and the heat cost factor (i.e. the furnace or boiler seasonal efficiency and the fuel cost.). The cost of insulating accessible rim joists is $.70 per lineal foot (or $.74 per square foot) is indicated by the Department of Energy and Economic Development price survey of contractor installed conservation measures. The cost of insulating inaccessible rim joists is estimated to be $1.40 per linear foot or $1.60 per square foot. The estimate is based on the price survey cost for rim joist insulation ($.70/linear foot) and an estimate of the cost of removing and repairing sections of basement ceiling to get at the rim joist ($.70 per linear foot).

It is cost-effective to install rim joist insulation to R-11 even if the rim joist is inaccessible. The simple payback periods for this measure calculated as demonstrated in footnote 3, are shown below.

Simple payback periods for rim joist insulation (in years).

Existing level of insulation	HCF = 1.3	1.65	1.80	2.08
Accessible				
R-0	3.2	2.5	2.3	2.0
R-3.5	8.1	6.4	5.9	5.1
Inaccessible				
R-0	6.8	5.4	4.9	4.3

For example in a building with no insulation in the rim joists between the first and second floor (i.e. inaccessible rim joists) and which is heated with a gas-fired furnace with a steady state efficiency of 75% and no vent damper or intermittent ignition (i.e. HCF = 1.65) the simple payback for insulating the rim joists may be calculated as follows:

R_0 = The construction materials and air space provide an R-4.
R_1 = The addition of R-11 insulation provides a total R-value of R-15 (11 + 4 = 15)
A = 1 square foot

C = $1.60/sq ft
HCF = 1.65 (See note 3)

$$SPB = \frac{C}{\Delta H \times HCF} = \frac{1.60}{(.18)\ (1.65)} = 5.4 \text{ years}$$

[6]Standard 12 requires that owners of residential rental property "install insulation in or on all walls and floors that enclose conditioned spaces to achieve a minimum total "R" value of the insulation of R-11. Walls must include foundation walls of basements, cellars or crawl spaces.

The factors which influence the cost effectiveness of this measure are the existing level of insulation, the cost of insulating an inaccessible wall cavity and the heating cost factor (i.e. the furnace or boiler seasonal efficiency and the cost of the fuel). According to the Department of Energy and Economic Development 1983 price survey of contractor installed prices for conservation measures, the cost of blowing insulation into an inaccessible wall cavity is $.75/sq. ft. for insulating walls with wood exterior siding or $1.10/sq. ft. for walls with other siding materials such as stucco.

Only in the case where 1" of insulation is already in the walls and a stucco building has an 80% steady state efficiency burner with an intermittent ignition and a vent damper (i.e. HCF = 1.3) is the simple payback for blowing cellulose into a wall cavity greater than 10 years.

Simple payback for adding wall insulation to an inaccessible wall cavity (in years)

Existing R-value	Siding material	Assumed cost per ft^2	HCF			
			1.3	1.65	1.80	2.08
0	wood	$ .75	3.2	2.5	2.3	2.0
3.5	wood	$ .75	8.2	6.5	6.0	5.2
0	stucco	$1.10	4.6	3.6	3.3	2.9
3.5	stucco	$1.10	12.7	10.0	9.1	7.9

A sample calculation for a building heated with a 75% steady state efficiency gas furnace with no intermittent ignition or vent damper and one inch of insulation in the existing walls and stucco exterior follows:

R_0 = R-7.5 (wall construction = R-4, insulation = R-3.5)
R_1 = R-15 (wall construction = R-4, insulation = R-11)

$$\Delta H = \left(\frac{1}{R_0} - \frac{1}{R_1}\right) \times A = \left(\frac{1}{7.5} - \frac{1}{15}\right) \times 1 = .067$$

C = $1.10/sq ft
HCF = 1.65 (see note 3)

$$SPB = \frac{C}{\Delta H \times HCF} = \frac{1.10}{(.067)\ (1.65)} = 10.0 \text{ years}$$

[7]Standard 12 requires that "insulation installed on the exterior of the foundation wall must extend down two feet below grade level."

The factors which influence the cost effectiveness of insulating foundation walls or the exterior are the existing level of insulation, and the heat cost factor. Insulating on the exterior costs $2.25/sq. ft. according to the 1983 price survey of contractor installed prices. The heating cost factor is dependent on the depth below grade to which the insulation is installed. The effective number of degree days to which a wall is exposed varies with the depth below grade. The heating cost factor for below grade construction must then be adjusted by a factor equal to the ratio of the average effective below grade degree days and the average above grade degree days. The average effective below grade degree days are calculated using the Decremented Average Ground Temperature Method developed by Akridge and Poulos at Georgia Institute of Technology. The average effective degree days at a depth of one foot below grade is 5,630 degree days. A depth of one foot is used for calculating the heat loss through the insulated portion of a wall insulated to a depth of 2 feet below grade since this is the average depth below grade for this portion of the wall. The adjustment factor for the heating cost factor is .69 (5630/8159) for one foot below grade. The heating cost factor adjusted for below grade can be calculated by multiplying the above grade heating cost factor by the appropriate adjustment factor:

HCF (below grade) = HCF (above grade) x below grade adjustment factor

For example, if the above grade heating cost factor is 1.3 and the insulating method is to install insulation to a depth of two feet below grade, the average depth below grade of this insulation is one foot and the appropriate adjustment factor is .69. Thus,

HCF (1 ft. below grade) = (1.3) (.69) = .90.

The table below indicates the below grade heating cost factors for one foot below grade and for four different heating cost factors.

Depth below grade	HCF			
0 ft.	1.3	1.65	1.80	2.08
1 ft.	.90	1.14	1.34	1.43

It is always cost effective to insulate foundation walls to 2 feet below grade when the existing wall is uninsulated. However, it is never cost effective if there is R-6 insulation in or on the existing walls. The simple payback periods for insulating uninsulated existing foundation walls below grade are shown in the table below.

For each linear foot of foundation wall insulated in this manner, approximately 2 feet of insulation is installed above grade from the bottom of the siding to the ground and 2 feet extends below ground level. Thus, four square feet of insulation are installed for each linear foot of foundation wall. The calculation of the energy savings must take into account the savings of energy

lost through the above grade portion as well as the below grade portion. Thus, total savings would be calculated as follows:

$$\text{Total Savings} = \Delta H_1 \times HCF_1 + \Delta H_2 \times HCF_2$$

where: ΔH_1= the difference in design heat less per degree Fahrenheit for the above grade portion of the wall.
HCF_1= the Heating Cost Factor for the above grade portion of the wall.
ΔH_2= the difference in design heat loss per degree Fahrenheit for the below grade portion of the wall.
HCF_2= the Heating Cost Factor for the below grade portion of the wall.

The simple payback is then calculated: $SPB = \frac{C}{\Delta H \times HCF_1 + \Delta H_2 \times HCF_2}$

Simple payback for insulating the exterior of foundation walls below grade (in years)

Existing Level of Insulation	HCF above grade / HCF 1 ft. below grade)	1.3 / .9	1.65 / 1.14	1.80 / 1.34	2.08 / 1.43
R-0		3.0	2.3	2.1	1.9
R-6		40.9	32.3	28.7	25.6

For example, the simple payback for insulating the uninsulated foundation walls on the exterior on a building heated with a 75% steady state efficiency gas-fired furnace with no vent damper or intermittent ignition may be calculated as follows. For each linear foot of foundation wall, two square feet of insulation are installed above grade and two below. Thus H_1 and H_2 are calculated using the areas of above and below grade wall.

R_0 = R-1.28 (for masonry foundation wall)
R_1 = R-11.48 (R-1.28 for foundation all + R-10.2 for two inches of extruded polystyrene insulation)
A_1 = two square feet
A_2 = two square feet

$$\Delta H_1 = \left(\frac{1}{1.28} - \frac{1}{11.48}\right) \times 2 = 1.39$$

$$\Delta H_2 = \left(\frac{1}{1.28} - \frac{1}{11.48}\right) \times 2 = 1.39$$

C = \$9.00 per linear foot (Four square feet at \$2.25 per square foot.)
HCF_1= 1.65
HCF_2= 1.14

$$SPB = \frac{C}{\Delta H_1 \times HCF_1 + \Delta H_2 \times HCF_2} = \frac{9.00}{(1.39 \times 1.65) + (1.39 \times 1.14)} = 2.3 \text{ years}$$

[8]Standard 12 states that "insulation installed on the interior or in the foundation wall must be installed from the bottom of the rim joist to the foundation slab or floor."

The factors which influence the cost effectiveness of insulating foundation walls on the interior are the existing level of insulation and the heating cost factor. Insulating on the interior by constructing and insulating a frame wall to which gypsum board is applied costs $1.65/ft. according to the 1983 price survey of contractor installed prices. A foundation wall which extends 6 feet below grade has an average depth below grade of three feet and is exposed to an average of 5,123 effective degree days. The heating cost factor for this below grade wall must, therefore, be adjusted. The adjustment factor is the ratio 5123/8159 or .628 (See note 8). The heating cost factors for a foundation wall an average of three feet below grade are shown in the table below.

Depth below grade	HCF			
0 ft.	1.3	1.65	1.80	2.08
3 ft.	.82	1.04	1.22	1.30

It is always cost-effective to insulate a foundation wall on the interior below grade when the existing wall is uninsulated. However, it is never cost effective if there is R-6 insulation in or on the existing walls. The simple payback periods for insulating on the interior of existing foundation walls are shown below:

Existing level of insulation	Simple payback in years for interior foundation insulation				
	HCF above grade	1.3	1.65	1.80	2.08
	HCF 3 ft.below grade	.82	1.04	1.22	2.80
R-0		2.5	2.01	1.7	1.6
R-6		28.3	22.3	19.5	17.8

For example, the simple payback for insulating the uninsulated foundation walls on the interior of a building heated with a 75% steady state efficiency gas-fired furnace with no vent damper or intermittent ignition may be calculated as follows:

R_0 = R-1.28 (For a 12' masonry foundation wall)
R_1 = R-13.28 (R-1.28 for the masonry wall and R-11 for the insulation + R-1 for the gypsum board and air film)
A_1 = two square feet (above grade wall area)
A_2 = 6 square feet (below grade wall area)

$$\Delta H_1 = \left(\frac{1}{1.28} - \frac{1}{13.28}\right) \times 2 = 1.41$$

$$\Delta H_2 = \left(\frac{1}{1.28} - \frac{1}{13.28}\right) \times 6 - 4.24$$

C = $13.20 per linear foot ($1.65 x 8 feet)
HCF_1 = 1.65
HCF_2 = 1.04

$$SPB = \frac{C}{\Delta H_1 \times HCF_1 + \Delta H_2 \times HCF_2} = \frac{13.20}{(1.41 \times 1.65) + (4.24 \times 1.04)} = 2.0 \text{ years}$$

[9]Standard 13 requires that owners of residential rental property "caulk, gasket or otherwise seal interior joints between foundation and rim joists, around window and door frames, between wall and ceiling, at joints between wall and trimboards, at cracks on interior surfaces of walls, and at utility penetrations."

The factors affecting the cost effectiveness of this measure are the cost of sealing the cracks, the size of the cracks and the heating cost factor. The 1983 price survey of contractor installed prices indicates that caulking costs $.65 per lineal foot of crack. The crack size influences the volume of air which is allowed to pass through and, therefore, the energy cost. Tables found in the Home Energy Disclosure Manual and developed from information in ASHRAE Handbook of Fundamentals give estimates of the volume of air-flow through various size cracks. For this example four sizes of cracks in the building envelope are considered: 1/32", 1/16", 1/8" and 1/4". The estimated volume of air flowing through these cracks is .14, .27, .54 and 1.08 cubic feet per minute per foot of each crack and holes in the building envelope.

It is always cost effective to caulk all cracks with at least 1/32" wide. The simple payback periods for caulking various size cracks in buildings with various heating cost factors are shown below:

Simple payback for caulking (in years)

Crack size	HCF = 1.3	1.65	1.80	2.08
1/32"	3.3	2.6	2.4	2.1
1/16"	1.7	1.4	1.2	1.1
1/8"	.9	.7	.6	.5
1/4"	.4	.3	.3	.3

For example in a building with cracks 1/32" wide and heated by a gas-fired 75% steady state efficiency furnace with no vent damper or intermittent ignition, the simple payback for caulking these cracks may be calculated as follows:

$\Delta H = 1.08\,\Delta I$ (This equation is based on heat loss calculation procedures outlined in ASHRAE Handbook of Fundamentals).
ΔI = cubic feet per minute of air passing through the crack

C = $ .65/lineal foot of crack
HCF = 1.65

$\Delta H = 1.08\ (.14) = .151$

$$SPB = \frac{C}{\Delta H \times HCF} = \frac{.65}{(.151)\ (1.65)} = 2.6 \text{ years}$$