Maine Residential Energy Standard

(Maine RES)

Maine State Planning Office

May 2002

Table of Contents

This work was prepared for the Maine State Planning Office by R.J. Karg Associates in cooperation with the Maine Department of Economic & Community Development, using funding from the US Department of Energy State Energy Program.

Introduction

In 1999, with financial support provided by the USDOE through a State Energy Program, Special Projects grant, the State Planning Office (SPO) initiated a project to examine what it would take to establish and support the use of voluntary model energy standards for residential building design and construction. As originally conceived the project had two parts. The first part consisted of developing a model residential energy building standard tailored to Maine conditions that would be the basis for guiding the building design and construction practices needed to achieve a higher level of energy performance. The second phase of the study was an analysis of the public and private infrastructure need to support the use of the voluntary standard, along with the preparation of a plan of action for upgrading or providing the necessary supporting tools, training, and services. R.J. Karg Associates was hired to conduct the studies and prepare the reports.

The consultant, with the assistance of SPO and the Energy Division of the Dept. of Economic and Community Development (DECD) prepared a working draft of a Maine Residential Energy Standard, which was used to solicit input from the building community and others interested in the topic. Based on the consultants' analysis and input from the stakeholders, the model Maine Residential Energy Standard (Maine RES) was established.

Surprisingly, an upgraded residential energy standard for Maine does not entail a significant change in construction techniques or materials, only some adjustments in building design and building practices. The major changes needed to improve energy performance includes more attention to design considerations, additional foundation insulation, and tighter construction to control air infiltration, coupled with the selection and installation of more efficient space heating and conditioning equipment.

The widespread use of this new standard will require the existence of an infrastructure of builders and technical assistance and services needed to support the use of the voluntary standard. Builders using the standard will need some training and supporting use of analysis tools to assure effective application of the standards. There will be a need for independent product certification and quality assurance services to assure consumer trust and protection. Most if not all of the necessary infrastructure already exist in one form or another, and as demand grows one could expect these supporting services to also grow to meet the need. One exception could be the need for a State certification for Maine RES evaluators and certifiers.

A strategic plan has been developed to promote and support the use of the Maine RES standard. This "marketing" plan evaluates and recommends implementation activities. The emphasis is on the promotion of the use of the standard, the actions necessary to prepare builders to apply the standard, and the elements of a public/private partnership needed to sustain the use of Maine RES.

Benefits of the Maine RES

The Maine RES standard is intended to serve as a voluntary energy performance standard designed to support private sector construction of energy-efficient homes. Using more energy-efficient design and construction practices can benefit builders, realtors, home owners, and the environment.

By applying the voluntary standard, builders have the opportunity to differentiate their homes from less efficient ones offered by competitors. Given that Maine's energy costs are some of the highest in the nation, greater energy efficiency can have considerable appeal to Maine consumers. Supporting documentation such as third party verification of compliance and/or the use of a performance label would provide building recognition and builder credibility that would improve the ability of builders and realtors to promote the advantages of energy-efficient construction to their customers.

The occupants of an energy efficient home benefit from increased thermal comfort during both winter and summer months. A related benefit is that a complying home is better isolated from outdoor noise and air pollutants when the doors and windows are closed. Although a Maine RES home may cost slightly more to build than one built to a lower efficiency standard, lower space-conditioning energy bills mean the Maine RES home costs less to own in the longer run. Increased comfort and lower energy costs can make a home more desirable and marketable.

Greater energy efficiency benefits the environment and the State by making more efficient use of natural resources, and by reducing emissions that contribute to smog, impaired human health, and global climate change. Greater energy efficiency also increases energy independence and energy security.

Overview of Maine RES

The Maine Residential Energy Standard (Maine RES) is a voluntary energy standard intended to raise the level of energy efficiency in new residential construction and renovation projects in Maine.[1] It is a model code for residential building practices and standards that will achieve enhanced energy performance consistent with national standards, adjusted for local climate variations and building types found in the state.

Maine RES is based on the most recent edition of the *International Energy Conservation Code* (IECC), published in February 2000 by the International Code Council and its national model code organizations: Building Officials and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI). The IECC was first published in 1998 as the successor for the national Model Energy Code (MEC).[2]

The IECC-2000 is a comprehensive energy conservation code that sets minimum design and construction parameters for buildings (of all types??). This code provides

[1]Additions, alterations, renovations or repairs to a building envelope, mechanical, service water-heating, electrical distribution or illumination systems or portion thereof should comply with the provisions of this standard as they related to new construction, without requiring the unaltered portion(s) of the existing system to comply. Source: IECC-2000, 101.4.2.2.
[2]Please refer to Appendix A for a summary of the residential sections of the IECC-2000.

both prescriptive and performance based elements.[3] The model code establishes minimum thermal performance requirements for building envelopes, sets minimum efficiency ratings for mechanical building systems and specifies other basic requirements (see Table 1) needed to achieve desired performance levels.

Based solidly on the IECC-2000 model, the Maine RES uses the same building envelope performance standards; the prescriptive values are merely adapted for Maine's climatic regions. Maine RES moves beyond the IECC-2000 only in the area of indoor air quality by including the accepted ASHRAE standard for achieving acceptable indoor air quality.[4] Otherwise, the two are the same.

For more than a decade, Maine has had an energy code (The Maine *Energy Efficiency Building Standards*) based on a national model energy code (MEC) that applies only to speculatively built residential buildings. A house built to Maine RES will use less energy than a house built to the current Maine law.[5] In some cases, the building envelope guidelines of Maine RES are the same as the Maine law; in other cases they set a higher standard. While the Maine law has no requirements for heating system efficiency, the Maine RES heating system efficiency guidelines call for equipment that is now typical available and commonly used in present practice.[6]

Builders should have no difficulty building to the Maine RES guidelines because no special new methods or materials are needed, just high quality windows, a little more insulation in some areas, and attention to detail to reduce air leakage.

Similar to the IECC-2000 model code, the Maine RES standard allows three alternative methods of meeting the standards: a prescriptive mode, a component performance path, and a systems analysis approach. These options offer flexibility in achieving a desired performance that should suit the needs of most designers, builders, and home owners. Each mode is explained below. Please refer to Appendix C for a summary of the *Energy Efficiency Building Performance Standards* required by Maine law.

Commercial buildings are not a part of this voluntary energy standard project because Maine law requires commercial buildings to comply with the current ASHRAE Standard 90.1, which is the prevailing national standard for commercial and institutional buildings. The Maine code updates automatically with each new version of the national standard.

Economic Impacts

An analysis of the economic impacts of using the Maine RES standards was prepared by the consultant (Economic Analysis for Maine Residential Energy Standard (Maine RES), R.J.Karg Associates). This analysis shows that the financial impacts of building to a higher energy standard are effective and affordable especially with the use of energy efficiency mortgages. In addition, an energy efficient house can be less costly to

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[3]"The New 2000 International Energy Conservation Code (IECC) is Available," Building Codes Assistance Project (BCAP) newsletter, March/April 2000, p. 11.
[4]ASHRAE Standard 62.2, *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. Please refer to Table 1.*
[5]Please see Appendix E, Table 6.
[6]Please see Appendix E, Tables 6 and 7 for comparisons of Maine RES and the Maine law.

operate, which will influence the cash flow in the household budget; and in most cases enhance the value of the house at the point of resale.

The incremental costs to achieve the higher level of energy performance inherent in the Maine RES standards range from under $1,000 to over $2,500 per house depending on the size of the building, the climatic location of the structure, and the bundle of improvements made. In the economic analysis study, the basis for measuring incremental improvement in performance is measured by comparing the Maine RES standards to the current Maine Residential Code.

The Maine RES standard is a more comprehensive guide than older codes and allows more design flexibility in achieving performance results. The enhanced energy standards used in the analysis of economic impacts includes lowering air infiltration rates, adding slightly more insulation to walls and ceilings and insulating foundation walls, and installing more fuel efficient central heating equipment.

This analysis demonstrates that in the majority of modeled houses the individual efficiency measures are cost-effective when measured by savings-to-investment ratio and simple payback tests. When the energy enhancements are measured as a group or bundle of measures the resulting annual savings are positive for all of the hypothetical models runs.

In addition to achieving direct energy savings, the analysis shows that a more energy efficient house can have lower household operational cost, thus increasing monthly cash flow balances in the household budget. Even though annual mortgage costs increase (if the incremental costs are rolled into the mortgage) the net present value of savings from the bundle of improvements is greater than the annualized cost of the measures. In the analysis, savings associated with lower energy usage range from $60 dollars a year to over $300 per year. When these savings are netted out against increased mortgage payments all of the modeled scenarios have a positive “cash flow” result, ranging from $3 to $84 per year.

Energy-efficient construction not only has the potential of creating a positive cash flow in the monthly household budget, it can also increase the resale value of the house. Studies of the resale value of houses as a function of energy efficiency find a positive relationship between energy efficiency and resale values. For each dollar of reduced energy cost the value of the home increases twenty dollars. This relationship applied to the houses modeled in the economic analysis show increased resale values from $1200 to $6180.

Granted the amount of savings is modest, probably not very influential in motivating consumer demand for more energy efficient homes. There is a modest increased cost to build to a higher standard, which can be recovered in a relatively short payback period or financed in the mortgage, but in either case consumers interested in reducing energy usage they will save money and reduce their longer term costs while living in a more comfortable house with greater market value.

Maine Residential Energy Standard

The Maine RES provides three methods of applying the standards - a prescriptive mode, a component performance path, and through a systems analysis approach. The large majority of the builders wishing to apply the Maine RES standards are likely to use one or some combination of the first two methods. For users of the prescriptive approach to higher energy performance, this document is not intended to supply all the necessary information. Users of the component performance approach will require specialized software or worksheets, described below. Users of the systems analysis approach will need to acquire a copy of the IECC-2000 for the necessary detailed analysis. These three options for achieving the desired energy performance can accommodate abroad range of builder/designer expertise, competence, and need.

Basic Provisions of Maine RES

Table 1 summarizes basic provisions of the Maine RES standard. These standards apply regardless of the application method selected. Notice that Table 1 does not include detailed building shell insulation or window or door insulation specifications because insulation provisions can vary by the application method selected and are therefore addressed in the description of implementation options following Table 1.

Table 1. Maine RES: Summary of Basic Provisions	
Air Leakage	Joints, penetrations, and all other such openings in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed. The maximum leakage rates for manufactured windows is 0.3 CFM per ft^2, for sliding doors 0.3 CFM per ft^2, and for swinging doors 0.5 CFM per ft^2. Recessed lights must be type IC rated and installed with no penetrations or installed inside an appropriate airtight assembly with a 0.5-in. clearance from combustible materials and 3-in. clearance from insulation.
Air Quality	Because air quality can be effected by construction techniques, follow recommendations of most recent version of ASHRAE Standard 62.2, *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings.*
Vapor Retarder	Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors.
Materials and Insulation Information	Materials and equipment must be identified so that compliance can be determined. Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided. Insulation R-values, glazing and door U-values, and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications. Exterior foundation wall and slab perimeter insulation must have a rigid, opaque, and weather-resistant covering that prevents degradation of the insulation's performance, covers the exposed (above-grade) area of the insulation, and extends to a minimum of 6 inches below grade.
Duct Insulation	Supply and return ducts for heating systems located in unconditioned spaces must be insulated to R-3.3 if temperature difference between duct air and ambient area is from 15 to $40^{O}F$ and R-5 if temperature difference between duct air and ambient area is more than $40^{O}F$. Ducts on the exterior of the building envelope must be insulated to R-8. *Exceptions: Insulation is not required for exhaust air ducts, ducts within HVAC equipment, and when the design temperature difference between the air in the duct and the surrounding air is $15^{O}F$ or less.*
Duct Construction	All joints must be sealed with mastic, metal tape, or mastic plus tape. Duct tape may not be used. Cooling ducts with exterior insulation must be covered with a vapor retarder. The HVAC system must provide a means for balancing air and water systems.
Equipment Performance	Heating, cooling, and water heating equipment must meet minimum efficiency requirements. - Furnaces: 78% AFUE - Boilers: 80% AFUE Refer to Table 503.2 in IECC-2000 for space cooling equipment minimum efficiencies and Table 504.2 for minimum performance of water heating equipment.
Temperature Controls	Thermostats are required for each separate HVAC system in single-family buildings and each dwelling unit in multifamily buildings (non-dwelling portions of multifamily buildings must have one thermostat for each system or zone). Thermostats must have the following ranges: For heating only, $55^{O}F$ to $75^{O}F$; For cooling only, $70^{O}F$ to $85^{O}F$; For heating/cooling, $55^{O}F$ to $85^{O}F$ and a dead band of at least $5^{O}F$.
HVAC Pipe Insulation	HVAC piping conveying fluids at temperatures from $120^{O}F$ to $200^{O}F$ must be insulated with one inch of pipe insulation.
Load Calculations	Load calculations for the purpose of sizing HVAC equipment shall be done with the procedures described in ASHRAE *Handbook of Fundamentals* or an equivalent procedure.
Swimming Pools	All heated swimming pools must have an on/off pool heater switch. Heated pools require a pool cover unless over 20% of the heating energy is from non-renewable sources. All swimming pool pumps must be equipped with a time clock.
Water Heater Heat Traps	Water heaters with vertical pipe risers must have a heat trap on both the inlet and outlet of the heater.
Conservation of Hot Water	Shower heads shall have a maximum flow of 2.5 gallons per minute measured at a pressure of 80 pounds per square inch.
Electric Systems	Each multifamily dwelling unit must be equipped with separate electric meters.
Note: Not all requirements are listed here. Those listed are selected as those most appropriate for residential buildings in Maine. Please refer to Chapter 5 of IECC-2000 for full details.	

Prescriptive Approach to Voluntary Implementation[7]

The prescriptive approach to voluntary application is most appropriate for small building contractors and owner-builders constructing low glazing-to-wall-ratio homes. This document is intended to provide enough information to achieve the desired performance outcomes.

Table 2. Prescriptive Building Envelope and Heating System Provisions of Maine RES

	Percentage Window Area to Gross Exterior Wall Area		
Building Element	**8%**	**12%**	**15%**
Glazing U-factor			
All Zones	0.35	0.35	0.35
Ceiling R-value			
Zone 1	38	38	49
Zone 2	38	49	49
Zone 3	49	49	49
Exterior Wall R-value			
All Zones	19	19	19
Floor over basement/crawl R-value			
All Zones	19	19	19
Basement wall R-value			
Zone 1	10	10	15
Zones 2 and 3	10	15	15
Central Boiler AFUE			
Zone 1	82%	84%	84%
Zones 2 and 3	84%	84%	87.5%
Central Furnace AFUE			
Zone 1	80%	82%	82%
Zone 2	81%	83%	85%
Zone 3	81%	84%	87%

- These prescriptive values were determined with MEC*check*-2000. Percentages are of gross exterior above-grade wall area.
- For glazing areas greater than 15%, use the component performance approach for compliance.
- The R-values levels for basement walls assumes the floor above the basement is not insulated.
- The R-values levels for floors over basement/crawl spaces assumes basement and crawl space walls below are not insulated.
- Zone 1 includes counties of Androscoggin, Cumberland, Hancock, Kennebec, Knox, Lincoln, Penobscot, Sagadahoc, Waldo, Washington, and York.
- Zone 2 includes counties of Franklin and Oxford.
- Zone 3 includes counties of Aroostook, Piscataquis, and Somerset. County groupings based on *International Energy Conservation Code* 2000, page 31.

Table 2 shows the prescriptive values that must be used to apply the Maine RES. This table is to be used for wood construction only. To use Table 2:

1. Select the appropriate climate zone for your location (See Table 3 for additional help);
2. Select the appropriate percentage glazing area to gross exterior wall area. The gross wall area includes all above grade wall area that encloses conditioned space; and
3. Find the U-factor or R-value for the appropriate building envelope components.

[7]Based on IECC-2000 MEC*check* software computations for Bangor and Caribou, Maine.

Table 3 - Heating Degree Day Values for Selected Maine Locations	
Augusta	7,550
Bangor	7,930
Bar Harbor	7,604
Belfast	7,297
Caribou	9,651
Corinna	8,563
Eastport	7,876
Farmington	8,866
Gardiner	8,073
Houlton	9,319
Joneboro	8,262
Kittery	6,700
Lewiston	7,244
Madison	8,489
Portland	7,378
Presque Isle	9,188
Rumford	8,109
Waterville	7,382
Woodland	8,171
These are base 65^{O}F annual Heating Degree Day values from MEC*check* software (version 3.0) climate data.	

Component Performance Approach to Implementation[8]

This approach is appropriate for all builders and some owner-builders constructing higher glazing-to-wall-ratio homes or those wishing to minimize costs associated with energy features for their particular location and design.

Unlike the prescriptive approach, this method allows flexibility and tradeoffs. For example, if a builder wishes to construct a house with many single-glazed stained glass windows, the builder may increase the insulating value of the wood wall to compensate for the additional heat loss through the stained glass, so that the building wall component (combined walls, glazing, and doors) meets the requirements of Maine RES. This weighted average insulating value for walls is $R_O = 9$ or $U_O = 0.11$ for all areas in Maine (think of the subscript "$_O$" as representing the "overall" insulating value).

For the component performance approach, the specified U_O-factors (minimum R_O-values) for Maine are:

- Walls, $U_O = 0.11$ ($R_O = 9$)
- Roof/ceilings, $U_O = 0.026$ ($R_O = 38$);
- Floors over unheated spaces, $U_O = 0.05$ ($R_O = 20$);
- Crawl space walls, $U_O = 0.06$ ($R_O = 17$);
- Basement walls,
  - For Heating Degree Days (HDD) from 4,501 - 8,500: $U_O = 0.11125 - (HDD \times 0.0000025)$;
  - For HDD from 8,501 - 9,000: $U_O = 0.6 - (HDD \times 0.00006)$; and
  - For more than 9,000 HDD: $U_O = 0.06$ ($R_O = 17$).

The disadvantage of this method compared with the prescriptive approach is its complexity. Mathematical calculations done by hand or computer software are necessary to assure success. Fortunately, the regularly updated MEC*check* software makes the component performance approach easy, fast, and flexible. See Appendix F for ordering information.

MEC*check* software is easy to use. It requires a PC computer with a 486 processor or better. The one-screen program allows the user to enter the building envelope insulating values and equipment efficiencies in an interactive manner—the program gives instant pass-or-fail results. The user may quickly alter the envelope insulating values and equipment efficiencies to ensure the desired results.

[8]Based on IECC-2000, Chapter 5.

If the user does not wish to use a computer and MEC*check* software, use of the component performance method can be calculated with the use of a "Trade-Off Worksheet." This takes longer than the MEC*check* software, but produces the same results. Please refer to Appendix G for a sample trade-off worksheet.

For effective use of the component performance approach, it is important to obtain the latest version of the MEC*check* software 3.0 and the accompanying software instructions or the *Trade-Off Worksheet Compliance Approach Manual*. See Appendix F for ordering information.

Systems Analysis Approach to Implementation[9]

This method of application is suited for builders who are interested in optimizing their designs by taking advantage of passive solar features, site orientation, and other elements of energy efficient design. Most builders and designers will never have a need to use this means of application, but it is important that it be available to those unique projects for which it is required. Use of this method requires the 2000 version of the MEC*check* software, the accompanying software instructions, and a copy of the *International Energy Conservation Code* (IECC-2000). See Appendix F for ordering information.

The systems analysis approach outlined in IECC-2000 also addresses buildings using renewable energy resources (for example, solar, geothermal, wind or other renewable energy sources). As modular renewable technologies become more cost-effective over time, there may be increasing customer demand for their installation.

Compliance by the systems analysis method requires mathematical calculation of the annual energy use for the *proposed building* and a *standard design building*. The calculated annual energy use of the proposed building must not be greater than the calculated use of a similar building of standard design. Rather than examining a limited number of building components for compliance, all components influencing energy use are included here.

In order for the *proposed building* to be considered comparable to the *standard design building*, the proposal must have:

- The same energy sources for the same functions;
- Equal areas of conditioned space;
- The same ratio of thermal envelope area to floor area — the same geometry;
- The same exterior design conditions, occupancy, climate data; and
    - A similar operational regime.

Standard design elements must be selected according to Chapter 5 of IECC-

How Maine RES Compares with Maine Law

Houses built to Maine RES would, on average, be about 30% more efficient than those built to Maine's *Energy Efficiency Building Performance Standards*. (Relative efficiency varies depending on the glazing-to-gross-wall-area ratio.) See Appendix E.

Maine RES would apply to all residential construction, while the Standards required by Maine law apply only to spec homes and buildings of more than two units. Please refer to Appendix E for more detailed information regarding a comparison of the voluntary Maine RES and the Maine mandatory statute. See Appendix C for a summary of the mandatory Maine *Energy Efficiency Building Performance Standards*.

[9]Based on IECC-2000, Chapter 4.

2000, Residential Building Design by Component Performance Approach, with these exceptions:

- Wall R-values used for the *standard design building* must be R-22 for 9,000 - 12,999 Heating Degree Days or R-19 for 6,500 - 8,999 Heating Degree Days;
- Fenestration U-factors used for the *standard design building* must be U-0.26 for 9,000 - 12,999 Heating Degree Days or U-0.28 for 6,500 - 8,999 Heating Degree Days;
- The window area for the *standard design building* must be equal to 18 percent of the conditioned floor area of the proposed design; and
- Skylights and other non-vertical roof glazing elements must not be included in the *standard design building.*

The process for applying the systems approach includes three steps:

1. Calculate the annual energy use of the *planned building* according to the requirements in the Chapter 4 of IECC-2000, Residential Building Design by Systems Analysis; and in Design of Building Utilizing Renewable Energy Sources if applicable. This provides a measure of expected energy usage.
2. Calculate the annual energy use of the comparable *standard design building* according to the requirements in Chapter 4 of IECC-2000. This is the norm for expected annual energy use in a comparable structure built to prescriptive standards.
3. Compare the annual energy use of the *planned building* with that of the *standard design building.* The *planned building* must have equal or lower annual energy use to achieve desirable performance. If it does not, the designer must alter the proposed building design to improve efficiency and performance.

Certification of Maine Residential Energy Standard

Application of the Maine RES standard is voluntary, but still needs to involve either 1) self-certification of compliance or 2) third-party inspection and certification of compliance.

For self-certification, builders, designers, or their agents merely certify, either in writing or orally, that a building adheres to the energy standards. The advantages of self-certification are simplicity and low cost. The self-certification process is easy, fast, and flexible with MEC*check* software. The primary disadvantage is that potential buyers and financing organizations are not as likely to value self-certification as highly as third-party certification of compliance.

Third-party inspection and certification of adherence to Maine RES are performed by an energy analyst from an independent organization. The primary advantage of third-party certification is increased credibility—an independent, objective party ensures potential buyers and financiers that the standard has been met. The disadvantages are that it takes more time and can be more costly than self-certification. Please refer to Appendix F for information about organizations that can confirm compliance with Maine RES as a third-party. As part of a third-party certification, it is best if a blower door test is part of

the analysis. This test will measure the tightness of the house and will give the analyst insight into the resulting level of indoor air quality.

For both self-certification and third-party certification, an energy label may be permanently affixed to an appropriate surface in the house. The Maine Residential Energy Standard Compliance Certificate—the energy label—lists all the characteristics that make up the energy profile of the house. The label is signed and dated by the self- or third-party certifier and makes it clear to future buyers that the house meets the Maine RES.[10] Please see Appendix D for a draft of this energy label.

Implementation of the Maine RES Standards

In phase two of this project the consultant, with SPO assistance, evaluated and recommended marketing options for promoting the use of Maine RES. The voluntary use of these energy performance standards has to occur within the functioning of market place forces. Forces that include the wishes and demands of consumers and their ability to purchase and operate a home, the interests and needs of builders to provide energy efficient homes that will satisfy customers needs, and the influences of realtors, bankers and mortgage lenders, and others in the housing industry.

The marketing strategy identifies key participants and infrastructural elements in the Maine residential marketplace that will need to be encouraged and supported to use the new standards. This strategy calls for a number of information and educational efforts to disseminate information, provide education and training sessions, and to generally promote the benefits of energy efficient homes.

The Maine housing industry on the supply side is already aware of the values of energy efficient construction, and provides housing to some level of efficiency, guided by existing codes and standards, and common building practices. Improving the general level of residential energy performance will require better informed consumers who demand and purchase more efficient structures. To this end the marketing strategy calls for a concerted effort to prepare and disseminate materials to home owners and potential buyers that promotes energy efficient homes based on the Maine RES standards.

Building housing to a higher level of energy performance will require active participation of designers and builders who are interested in providing high performance units that meet the needs of their customers. The marketing strategy calls for the preparation of builders manuals, planning and evaluation tools, and training sessions on the use of the new standards. In addition, certification services with adequate consumer protections will needed to evolve from existing professional services to assist and support builders in achieving the performance results incorporated in the standards.

In addition, the marketing plan calls for efforts to inform and educate various players in the housing industry to inform and promote the use of the Maine RES standards as the standard for energy efficient buildings.

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[10]Maine Residential Energy Standard Compliance Certificates signed and dated by third-party certifiers are expected to be of more value to future realtors and potential home buyers than those signed by builders (self-certification).

This document presents the Maine RES, a model voluntary standard for improving the energy performance of Maine homes. In doing this project the SPO hopes the building industry and others who influence residential building design and construction will find the new standards useful in improving residential energy efficiency.

Appendices

Appendix A: Overview of Residential Sections of the *International Energy Conservation Code* (IECC-2000)

Chapter 1. Administration and Enforcement

Because the language of this chapter assumes a mandatory and enforced energy code, parts of it may not be appropriate for the voluntary Maine RES. If compliance verification inspections are performed by third parties, sections of this chapter will be relevant.

Chapter 2. Definitions

This chapter defines terms important for the proper use of the IECC. A few terms are defined here for the clarification of this summary.

Building. Any structure occupied or intended for supporting or sheltering any use or occupancy.

Commercial Building. All buildings over three stories in height above grade or buildings, other than residential buildings, that are three stories or less in height above grade.

Residential Building, Type A-1. Detached one- and two-family dwellings.

Residential Building, Type A-2. A building containing multiple (that is, three or more) dwelling units where the occupants are primarily permanent in nature, such as townhouses, row houses, apartment houses, convents, monasteries, rectories, fraternities and sororities, dormitories, and rooming houses, all of which are three stories or less in height above grade.

Chapter 3. Design Conditions

This chapter sets the outdoor design conditions for Maine and all other states. The sixteen counties in Maine are grouped into three IECC climate zones; Zones 15, 16, and 17.

Chapter 4. Residential Building Design by Systems Analysis and Design of Buildings Utilizing Renewable Energy Sources

Chapter 4 of the IECC covers the requirements for the *systems analysis approach* of compliance for residential buildings. “This chapter establishes design criteria in terms of total energy use by a residential building, including all of its systems.”[11] Compliance by this method requires mathematical calculation of the annual energy use of the *proposed building* and a *standard design building*. The calculated annual energy use of the *proposed building* must not be greater than the calculated use of a similar building of *standard design building*.

Of the three methods of residential compliance with the IECC, this is the most flexible and the most complex. Rather than examining a limited number of components for compliance, all components influencing energy use are included here. “One way of thinking about this performance-based method is that you don’t have to par every hole,

[11] *International Energy Conservation Code 2000,* page 63.

just par the course."[12] Most builders and designers will never have a need to use this means of compliance, but it is important that it be available to those unique projects for which it is required.

The analysis in this chapter also allows design guidelines and compliance for buildings using renewable energy resources. "A proposed building utilizing solar, geothermal, wind or other renewable energy sources for all or part of its energy source shall meet the requirements. . ."[13]

In order for the proposed building to be considered comparable to the standard design building, it must have:

- The same energy sources for the same functions;
- Equal conditioned floor area;
- The same ratio of thermal envelope area to floor area — the same geometry;
- The same exterior design conditions, occupancy, climate data; and
- A similar operational schedule.

Standard design elements must be selected according to Chapter 5, Residential Building Design by Component Performance Approach, with these exceptions:

- Wall R-values used for the standard design building must be R-22 for 9,000 - 12,999 Heating Degree Days or R-19 for 6,500 - 8,999 Heating Degree Days;
- Fenestration U-factors used for the standard design building must be U-0.26 for 9,000 - 12,999 Heating Degree Days or U-0.28 for 6,500 - 8,999 Heating Degree Days;
- The window area for the standard design building must be equal to 18 percent of the conditioned floor area of the proposed design; and
- Skylights and other non vertical roof glazing elements must not be included in the standard design building.

Chapter 5. Residential building Design by Component Performance Approach

Chapter 5 of the IECC covers the *component performance approach* and serves as the centerpiece for residential compliance. Unlike the prescriptive approach, this method allows some flexibility and tradeoffs. A designer or builder may comply with this method by meeting the requirements for each building envelope component (wall, roof/ceiling, or floor).

For example, Chapter 5 requires the overall thermal transmission loss of an exterior wall assembly to be equal to or less than 0.11 (U_O = 0.11) for the Heating Degree Day range of 7,001 - 13,000 (this covers all of Maine). This is equivalent to an overall R-value of 9. *This overall U-factor or corresponding R-value must take into account the square feet and insulating values of 1) the opaque exterior wall area, 2) all glazing within the exterior wall, and 3) all opaque doors within the exterior wall.* Using the component performance approach, a designer or builder can trade off among the insulating values of these three elements that make up the wall assembly as long as its overall U-factor is 0.11 or less.

[12]Mark Madison, "Making Sense of the Model Energy Code," *Journal of Light Construction*, November 1999, p. 70.
[13]IECC-2000, Section 403.1, p. 66.

Some other important maximum U_O-factors for Maine:

- Roof/ceilings, U_O = 0.026 (R-38);
- Floors over unheated spaces, U_O = 0.05 (R-20);
- Crawl space walls, U_O = 0.06 (R-17);
- Basement walls,
  - For Heating Degree Days (HDD) from 4,501 - 8,500: U_O = 0.11125 - (HDD x 0.0000025);
  - For HDD from 8,501 - 9,000: U_O = 0.6 - (HDD x 0.00006); and
  - For more than 9,000 HDD: U_O = 0.06 (R-17).

In addition, Chapter 5 allows compliance by "total building envelope performance." In other words, the building may deviate from the required U_O-factors—such as U_O = 0.11 for exterior wall assemblies in Maine—if the total building thermal transmission loss ". . .for the proposed building envelope does not exceed the total heat. . . loss resulting from the proposed building's conformance to the values specified in. . ." the tables in this chapter.[14] This approach allows a greater degree of flexibility than the strict component performance approach, but not as much flexibility as the systems analysis approach of Chapter 4.

For example, if a builder wishes to construct a house that does not meet the requirement of U_O = 0.11 for exterior wall assemblies in Maine, the builder may compensate for the additional heat loss through the walls by reducing the heat loss through other surfaces.

Finally, a builder may comply with the requirements of this chapter by "prescriptive specification on an individual component basis." The requirements for the climate range in Maine are included in Table 4.

Table 4
Prescriptive Building Envelope Requirements of IECC-2000, Chapter 5

	Maximum Percentage Glazing Area to Gross Exterior Wall Area					
Envelope Component	***8%***	***12%***	***15%***	***18%***	***20%***	***25%***
Glazing U-factor						
6,500 - 6,900 HDD	0.43	0.4	0.35	0.33	0.3	0.25
7,000 - 12,999 HDD	0.42	0.4	0.35	0.33	0.3	0.25
Ceiling R-value						
6,500 - 12,999 HDD	38	49	49	49	49	49
Exterior Wall R-value						
6,500 - 12,999 HDD	16	21	21	22	26	19
Floor R-value						
6,500 - 6,900 HDD	19	19	21	25	21	30
7,000 - 12,999 HDD	19	19	21	30	21	30
Basement Wall R-value						
6,500 - 6,900 HDD	10	10	11	11	11	14
7,000 - 8,499 HDD	11	10	11	15	11	15
8,500 - 8,999 HDD	16	16	18	19	19	28
9,000 - 12,999 HDD	16	16	19	19	19	28

Note: HDD is Heating Degree Days, base 65^{O}F. The included HDD ranges cover all of Maine's climate zones.
Source: IECC-2000, pages 80 - 83.

[14]IECC-2000, Section 502.2.2, p. 79.

Chapter 6. Simplified Prescriptive Requirements for Residential Buildings, Type A-1 and A-2

Chapter 6 of the IECC addresses a simplified *prescriptive approach*. This four-page long chapter merely dictates insulation levels, making compliance fast and easy. Table 5 lists the prescriptive requirements of this chapter for the Maine climate zones. These requirements are the same as those for the 15 percent window area requirements in Chapter 5 Residential building Design by Component Performance Approach. This approach does not take air leakage into account for the purpose of determining compliance.

Chapter 7. Building Design for All Commercial Buildings

[Note: Because the Maine statute Energy Efficiency Building Performance Standards requires commercial buildings to be in compliance with the current version of ASHRAE 90.1, this chapter will not be used or referenced by Maine RES.]

Chapter 8. Design by Acceptable Practice for Commercial Buildings

[Note: Because the Maine statute Energy Efficiency Building Performance Standards requires commercial buildings to be in compliance with the current version of ASHRAE 90.1, this chapter will not be used or referenced by the Maine RES.]

Table 5
Prescriptive Building Envelope Requirements of IECC-2000, Chapter 6

	15% Maximum Window Area of Gross Exterior Wall Area
Envelope Component	
Glazing U-factor	
6,500 - 6,900 HDD	0.35
7,000 - 12,999 HDD	0.35
Ceiling R-value	
6,500 - 12,999 HDD	49
Exterior Wall R-value	
6,500 - 12,999 HDD	21
Floor R-value	
6,500 - 6,900 HDD	21
7,000 - 12,999 HDD	21
Basement Wall R-value	
6,500 - 6,900 HDD	11
7,000 - 8,499 HDD	11
8,500 - 8,999 HDD	18
9,000 - 12,999 HDD	19

Note: HDD is Heating Degree Days, base 65^{O}F. The included HDD ranges cover all of Maine's climate zones.
Source: IECC-2000, page 94.

Appendix B. Example for Sun Room Exemption to Maine RES

This sun room exemption example and related definitions are included here for the purpose of discussion. The IECC 2001 supplement to the IECC-2000 is likely to include a sun room exemption similar to this, however, the exact wording is not known at this time.[15] Proposed text to be added to IECC-2000 by the IECC-2001 supplement is underlined.

Revise 502.2.5 as follows:

502.2.5 Prescriptive path for additions and window replacements. As an alternative to demonstrating compliance with Section 402.1 or 502.2, additions with a conditioned floor area less than 500 square feet (46.5 m^2) to existing single-family residential buildings and structures shall meet the prescriptive envelope component criteria in Table 502.2.5 for the designated heating degree days (HDD) applicable to the location. The *U*-factor of each individual fenestration product (windows, doors and skylights) shall be used to calculate an area-weighted average fenestration product *U*-factor for the addition, which shall not exceed the applicable listed values in Table 502.2.5. For additions, <u>other than sun room additions</u>, the total area of fenestration products shall not exceed 40 percent of the gross wall and roof area of the addition. The *R*-values for opaque thermal envelope components shall be equal to or greater than the applicable listed values in Table 502.2.5. Replacement fenestration products where the entire unit, including the frame, sash and glazing, is replaced) shall meet the prescriptive fenestration *U*-factor criteria in Table 502.2.5 for the designated HDD applicable to the location. <u>Conditioned sunroom additions shall be served by a separate heating or cooling system, or shall controlled as a separate zone of</u> <u>the existing system</u>. Fenestration products used in additions and as replacement windows in accordance with this section shall also meet the requirements of Section 502.1.5 in locations with HDD less than 3,500.

Exception: Replacement skylights shall have a maximum *U*-factor of 0.50 when installed in any location above 1,999 HDD.

▪

Add definition to 202 as follows:

GENERAL DEFINITIONS

<u>SUNROOM ADDITION:</u> <u>A one-story structure added to an existing dwelling with a glazing area in excess of 40 percent of the gross area of the structure's exterior walls and roof.</u>

<u>THERMAL ISOLATION:</u> <u>A separation of conditioned spaces, between a sunroom and a dwelling unit, consisting of existing or new wall(s), doors, and/or windows. New wall(s), doors, and/or windows shall meet the prescriptive envelope component criteria in Table 502.2.5.</u>

[15]The 2001 supplement to the IECC-2000 is due to be released early in 2001. The above is based on a draft version of this supplement that is expected to be approved.

Appendix C. Brief Summary of the *Energy Efficiency Building Performance Standards*, the Maine Statute.

Some residential buildings in Maine must comply with the *Energy Efficiency Building Performance Standards*. "Except as stated below, any single-family and multifamily residential structure designed for year-round or winter seasonal use must comply with the prescriptive or performance standards."[16] The exemptions are:

- Single-family residences built by an individual for his or her personal residence.
- Single-family residences built by a contractor hired by an individual to build that individual's personal residence.
- Log homes built by anyone.
- Summer camps (heating the structure is not intended) built by anyone.

Speculatively built one- and two-dwelling unit buildings and all residential buildings of more than two dwelling units must comply with the statute.

Waivers to mandatory compliance are available for a number of building classifications, including renovations of historic buildings.

The *prescriptive approach* is the easiest compliance method for builders and designers. If their design adheres to the following requirements, their building complies. This is a simple, easy to understand compliance method requiring no calculations. However, it is an inflexible method allowing no tradeoffs.

The prescriptive requirements are:

- Ceilings must be insulated to at least R-38.
- Walls must be insulated to at least R-19.
- Floors over unheated spaced must be insulated to at least R-19.
- Slab-on-grade floors must be insulated to at least R-10.
- Foundation walls must be insulated from the top of the foundation to the frost line to at least R-10.
- All windows must have a minimum insulating value of R-2.

The other method of compliance is the performance approach. Unlike the prescriptive approach, this method allows flexibility and tradeoffs. If a builder wishes to construct a house with a flat roof that will be insulated only to R-19 rather than the prescriptive value of R-38, the builder may compensate for the additional heat loss through the roof by reducing the heat loss through other surfaces. The disadvantage of this method is its complexity compared with the prescriptive approach.

The performance approach requirement is:

"A house may comply with the Standards by the performance compliance alternative if the energy usage of the proposed building design is not greater than that of a standard building design. In other words, if it is properly demonstrated that the proposed building will not use any more energy than it would if [it] were a standard building (built to the prescriptive standards), it is deemed to be in compliance."[17]

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[16] *Maine Guide to Energy Efficient Residential Construction: A Manual of Accepted Practices*, 2nd ed., 1992, page 5.
[17] *Maine Guide to Energy Efficient Residential Construction: A Manual of Accepted Practices*, 2nd ed., 1992, page 83. Please refer to this document for more details.

Appendix D. Draft of Maine RES Compliance Certificate Label

Maine Residential Energy Standard Compliance Certificate

Site: _____
Address *Town* *Zip*

Electric Utility: _____

Construction Start/Completion Date: _____ / _____
Month / Year *Month / Year*

Project Description: ❑ Single-family ❑ Log Home ❑ Addition Conditioned
❑ Multifamily Units _____ # Stories _____ sq.ft. _____

Foundation Type: ❑ Basement ❑ Crawl space ❑ Slab on grade

Floors: R-_____Perimeter slab edge R-_____Under slab
R-_____Over unheated spaces

Walls: R-_____Non-basement R-_____Basement
R-_____Crawl space Depth/insulation:_____ft.

Ceilings: R-_____Flat R-_____Sloped

Doors: U-_____ U-_____ U-_____Glass doors

Windows: U-_____NFRC/Default Rating U-_____NFRC/Default Rating
(Circle rating type) *(basement)*
U-_____NFRC/Default Rating U-_____NFRC/Default Rating

Net window glazing (*rough opening*) area as a percent of gross exterior wall area:_____%

Space Heat: **Fuel:** ❑ Oil ❑ Natural Gas ❑ Kerosene ❑ Propane ❑ Wood
❑ Electric Resistance ❑ Heat Pump ❑ Solar ❑ Other

(*Check all that apply, Circle primary fuel and system)* **System:** ❑ Boiler ❑ Furnace ❑ Space Heater ❑ Stove ❑ Other

Primary heating system efficiency_____ ❑ AFUE ❑ HSPF

Air Conditioning Central A/C system efficiency_____ ❑ SEER ❑ COP ❑ EER

Domestic Hot Water: **Fuel:** ❑ Oil ❑ Natural Gas ❑ Kerosene ❑ Propane ❑ Wood
❑ Electric Resistance ❑ Heat Pump ❑ Solar ❑ Other

(*Check all that apply, Circle primary fuel and system)* **System:** ❑ Stand-Alone Tank ❑ Indirect-Fired Tank ❑ Tankless Coil
❑ On Demand ❑ Other

Domestic water heating system efficiency_____Energy Factor (EF)

Compliance Path: ❑ Prescriptive ❑ Component Performance ❑ Systems Analysis

MEC*check* maximum allowed UA_____ Your home's UA_____

HERS Rating: *(Optional)* Home Energy Rating (HERS) of your home_____ Date_____

HERS rating organization _____

Other Energy Features:_____

I certify to _____, owner, that this premises has been constructed in accordance with Maine Residential Energy Standard.

I certify to _____, owner, that this premises has been constructed in accordance with the federal EPA ENERGYSTAR Homes® Program.

_____ _____
Signature of ❑ *Builder* ❑ *Third-Party Inspector* *Organization*

_____ _(_____)_____ _____
Print Name *Telephone* *Date*

Permanently affix this label to the inside of the electrical service panel, on the heating or cooling equipment, or in another visible location

Questions? Call the Department of Economic and Community Development at 287-XXXX or 1-800-XXX-XXXX.

Appendix E. Maine *Energy Efficiency Building Performance Standards* Compared with 2000 *International Energy Conservation Code* and the ENERGY STAR voluntary standard

The results below show that the Maine *Energy Efficiency Building Performance Standards* are not as stringent—in most cases—as the *International Energy Conservation Code* (IECC-2000). Maine RES uses the same envelope standard as IECC-2000.

Table 6
Maine *Energy Efficiency Building Performance Standards* Compared with 2000 IECC/MEC*check* Efficiency Level (Maine RES) for a One- and Two-Story Dwellings in Augusta, Maine

	960 ft^2 One-Story Dwelling	1920 ft^2 Two-Story Dwelling
Percent Glazing	**Present ME statute**	**Present ME statute**
8	4.1% less efficient	1.0% more efficient
12	17.6% less efficient	14.6% less efficient
15	28.3% less efficient	27.6% less efficient
18	37.7% less efficient	40.4% less efficient
20	46.9% less efficient	49.8% less efficient
25	68.0% less efficient	74.4% less efficient

- Maine *Energy Efficiency Building Performance Standards* include R-38 ceilings, R-19 walls, R-10 basement walls, R-19 floors, and U-0.5 windows.
- One story dwelling is 40' x 24' with full basement (2' above grade, 6' below grade).
- Two story dwelling is 40' x 24' with full basement (2' above grade, 6' below grade).
- These comparison values will change for different areas of Maine. Augusta was selected as a midrange winter climate for the state.
- "Percent Glazing" is the ratio of glazing square feet to gross above grade wall area square feet.
- "more efficient" means greater efficiency than the 2000 IECC/MEC*check* standard.
- "less efficient" means lower efficiency than the 2000 IECC/MEC*check* standard.

The federal ENERGY STAR Home Program voluntary standard is 30 percent more efficient than the 1993 Model Energy Code and about 15 percent more efficient than the 1995 Model Energy Code. For some houses the ENERGY STAR Home Program voluntary standard and the IECC-2000/Maine RES level of efficiency are comparable.

Table 7 shows a comparison of the Maine Energy Efficiency Building Standards -- a Maine law -- and Maine RES. Notice that Maine RES is not significantly more stringent than the Maine law.

Neither Maine RES nor the Maine law specify a level of envelope tightness, although the Maine RES does specify tightness levels for windows and some general guidelines for construction practices affecting tightness.[18] If these guidelines are followed, it is likely that a Maine RES house will be tighter than a house built to the Maine law.

Maine RES is just an incremental more stringent than the Maine law, as shown in Table 7. In some cases, the building envelope guidelines of Maine RES are the same as the Maine law; in other cases they are just one step more efficient. While the Maine law has no requirements for heating system efficiency, the Maine RES heating system efficiency guidelines call for equipment that is typical by present practice.

[18]Please see Table 1, Maine RES: Summary of Basic Residential Provisions, in the row titled "Air Leakage".

Table 7
Proposed Prescriptive Building Envelope and Heating System Provisions of Maine RES

	Prescriptive Values for Envelope and Heating Systems	
Building Element	**Maine Law**	**Maine RES with 12% Glazing**
Glazing U-factor		
All Zones	0.5	0.35
Ceiling R-value		
Zone 1	38	38
Zone 2	38	49
Zone 3	38	49
Exterior Wall R-value		
All Zones	19	19
Floor over basement/crawl R-value		
All Zones	19	19
Basement wall R-value		
Zone 1	10	10
Zones 2 and 3	10	15
Central Boiler AFUE		
Zone 1	N/A	84%
Zones 2 and 3	N/A	84%
Central Furnace AFUE		
Zone 1	N/A	82%
Zone 2	N/A	83%
Zone 3	N/A	84%

-The R-values levels for basement walls assumes the floor above the basement is not insulated.
- The R-values levels for floors over basement/crawl spaces assumes basement and crawl space walls below are not insulated.
- *The Energy Efficiency Building Performance Standards*, a Maine law, does not include values for the efficiency of heating systems, therefore these items are marked with N/A.
-Zone 1 includes counties of Androscoggin, Cumberland, Hancock, Kennebec, Knox, Lincoln, Penobscot, Sagadahoc, Waldo, Washington, and York.
- Zone 2 includes counties of Franklin and Oxford.
- Zone 3 includes counties of Aroostook, Piscataquis, and Somerset. County groupings based on *International Energy Conservation Code* 2000, page 31.

Appendix F. Sources of Information and Contacts

International Energy Conservation Code (IECC-2000)

The Maine energy efficiency standard (Maine RES) is based on the *International Energy Conservation Code* (IECC-2000) and its 2001 supplement (expected to be released during the second half of 2000). The *International Energy Conservation Code* (IECC-2000) is available from BOCA International, Customer Service, 4051 West Flossmoor Road, Country Club Hills, IL 60478-5795, (800) 214-4321. The cost is $28.00. The document may also be ordered on-line from www.bocai.org/puborder.htm.

MEC*check* compliance software and accompanying instructions

The regularly updated MEC*check* software makes component performance compliance easy, fast, and flexible. The MEC*check* software and accompanying instruction manuals are available from the US Department of Energy at 800-270-2633 or can be downloaded directly from www.energycodes.org/meccheck/mecdownload.html.

Trade-Off Worksheet Compliance Approach Manual

The trade-off approach is used for component performance compliance. This instruction manual—T*rade-Off Worksheet Compliance Approach*—is available from the US Department of Energy at 800-270-2633 or can be downloaded directly from www.energycodes.org/meccheck/mecdownload.html.

Maine Guide to Energy Efficient Residential Construction: A Manual of Accepted Practices

The Maine statute *Energy Efficiency Building Performance Standards* is included as Appendix C for the convenience of the reader and is explained in detail in the *Maine Guide to Energy Efficient Residential Construction: A Manual of Accepted Practices*, 2nd ed. This guide is available from the Department of Economic and Community Development (DECD), 59 State House Station, Augusta, ME 04333-0059, (207) 287-2656.

Third-Party Verification of Compliance with Maine RES

1. Horizon Residential Energy Services, third-party inspection/energy auditing organization. (Note: This private service is listed here for the convenience of builders and homeowners because it is the only service of its kind -- can verify Maine RES and ENERGYSTAR compliance -- in the state as of November 2001.)

   As of November 2001, Horizon Residential Energy Services will perform a Home Energy Rating (HERS) for $300 for buildings up to 2000 square feet plus an additional $100 for each 1000 square feet in excess of 2000 square feet (for a building from 2001 to 3000 square feet, an analysis will cost $400). For multifamily buildings, a HERS rating for the first unit is $300 plus $100 for each additional unit

up to four units per building. These costs are current as of November 2001 and are subject to change. There is no difference in cost between a HERS rating for compliance with Maine RES and one for the higher level of energy efficiency—EPA ENERGYSTAR Homes® Program. Maine RES does not require a certified HERS rater for third-party inspection for compliance.

For more information, contact Wes Riley, Horizon Residential Energy Services, 38 Whitehouse Road, Hollis, Maine 04042. Voice: 727-5180. E-mail: wesr@horizon-res.com.

2. Maine Low-Income Weatherization Program energy auditors. There are eleven agencies in Maine that deliver the federal low-income weatherization program. The energy auditors that work within this program may be able to third-party confirm compliance with Maine RES. For more information, call your local Community Action Program, Low-Income Weatherization division.

Maine RES project contractor and project contact

Rick Karg
R.J. Karg Associates
220 Meadow Road
Topsham, ME 04086
voice: 725-6723
fax: 725-7818
e-mail: rjkarg@karg.com

MECcheck

Trade-Off Worksheet

Enforcement Agency:

Builder Name _____ Date _____ Permit # _____

Builder Address _____

Building Address _____ Zone # _____ Checked By _____

Submitted By _____ Phone Number _____ Date _____

PROPOSED

U-values and F-values can be found in Tables 4-1 through 4-10.

Ceilings, Skylights, and Floors Over Outside Air

Description	Insulation R-Value	U-Value	x Area	= UA
Ceiling			ft²	
Floor Over Outside Air			ft²	
Skylight			ft²	
			ft²	
			ft²	
Ceilings: Total Area			ft²	

Walls, Windows, and Doors

Description	Insulation R-Value	U-Value	x Area	= UA
Wall			ft²	
Window			ft²	
Door			ft²	
Sliding Glass Door			ft²	
			ft²	
			ft²	
			ft²	
Walls: Total Area			ft²	

Floors and Foundations

Description	Insulation Depth	Insulation R-Value	U-Value or F-Value	x Area or Perimeter	= UA
Floor Over Unconditioned				ft²	
Basement Wall				ft²	
Unheated Slab	in.			ft	
Heated Slab	in.			ft	
Crawl Wall	in.			ft²	

Total Proposed UA _____

REQUIRED

Required U-values can be found in Table 4-11.

Required U-Value	x Area	= UA
	ft²	

Required U-Value	x Area	= UA
	ft²	

Required U-Value or F-Value	x Area or Perimeter	= UA
	ft²	
	ft²	
	ft	
	ft	
	ft²	

Total Required UA _____

Total Proposed UA must be less than or equal to the *Total Required UA*.

Statement of Compliance: The proposed building design represented in these documents is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the requirements of the 1995 CABO Model Energy Code.

Builder/Designer _____ Company Name _____ Date _____

MECcheck

Trade-Off Worksheet

Enforcement Agency:
Permit #
Checked By
Date

Builder Name ABC BUILDERS Date JUNE 10, 2000

Builder Address

Building Address AUGUSTA, ME, RANCH W/ 12% GLASS Zone # 15

Submitted By Phone Number

PROPOSED

U-values and F-values can be found in Tables 4-1 through 4-10.

Ceilings, Skylights, and Floors Over Outside Air

Description	Insulation R-Value	U-Value	x Area	= UA
Ceiling	49	0.026	960 ft²	25.0
Floor Over Outside Air			ft²	
Skylight			ft²	
			ft²	
			ft²	
Ceilings: Total Area			960 ft²	

Walls, Windows, and Doors

Description	Insulation R-Value	U-Value	x Area	= UA
Wall	19+5	0.054	830 ft²	44.8
Window		0.35	154 ft²	53.9
Door		0.4	40 ft²	16.0
Sliding Glass Door			ft²	
			ft²	
			ft²	
			ft²	
Walls: Total Area			1024 ft²	

Floors and Foundations

Description	Insulation Depth	Insulation R-Value	U-Value or F-Value	x Area or Perimeter	= UA
Floor Over Unconditioned				ft²	
Basement Wall		10	0.072	1024 ft²	73.7
Unheated Slab	in.			ft	
Heated Slab	in.			ft	
Crawl Wall	in.			ft²	

Total Proposed UA: 213.1

REQUIRED

Required U-values can be found in Table 4-11.

Required U-Value	x Area	= UA
0.026	960 ft²	25.0

Required U-Value	x Area	= UA
0.11	1024 ft²	112.6

Required U-Value or F-Value	x Area or Perimeter	= UA
	ft²	
0.075	1024 ft²	76.8
	ft	
	ft	
	ft²	

Total Required UA: 214.4

Total Proposed UA must be less than or equal to the *Total Required UA*.

Statement of Compliance: The proposed building design represented in these documents is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the requirements of the 1995 CABO Model Energy Code.

John Black — Builder/Designer

ABC Builders — Company Name

6/10/00 — Date