# Greening the BC Building Code

by Murray Frank, Constructive Home Solutions

*Synopsis*

An examination of the new green requirements for the BC Building Code which come into effect on September 5, 2008 and the impact that these changes will have on various regions throughout the province. The presentation will include an analysis of a sample house and a cost comparison of various insulating strategies that satisfy the new requirements.

PRESENTATION GUIDE


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# Greening the BC Building Code

## Code Change Seminar

**Special Seminar ▸ Building and Safety Policy Branch / Homeowner Protection Office ▸ 2008**


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The Homeowner Protection Office (HPO) is a provincial Crown Corporation with a mandate to protect new home buyers from undue risk and assist the residential construction industry to mitigate that risk. As part of our research and education function, our goal is to provide access to the latest research results, improved technology and best practices. This Code change seminar has been developed to assist in bringing this practical information and knowledge to industry professionals across British Columbia.


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Constructive Home Solutions Inc. performs building envelope design and assessments. Murray Frank has been an instructor of building science at the University of British Columbia, the British Columbia Institute of Technology, Camosun College and other North American post secondary education institutions. Mr. Frank's combined technical expertise and practical experience in the residential, industrial, commercial and institutional sectors helps bring about an understanding of construction issues found in the various climate regions throughout British Columbia.


**Reference Materials and Acknowledgements**:

Reference materials used in the preparation of portions of this Presentation Guide include the Information Bulletin from the Building & Safety Policy Branch No. B08-01, "New Greening Requirements in the BC Building Code" and the text of the Code changes. A special mention is given to Select Home Designs for the use of their Copyrighted home design drawings and documents used for the purpose of the case study presented, Hanscomb Limited for their services as Quantity Surveyor and costing providers for the case study, and e3 eco group inc for their services in providing the EnerGuide for New House evaluations for the case study.

# Contents

# Greening the BC Building Code:

## Code Change Seminar

### Greening of the BC Code

On April 15, 2008, the Office of Housing and Construction Standards, Building & Safety Policy Branch announced the new green requirements in the BC Building Code. These provisions reflect the Province's commitment to reduce greenhouse gases related to buildings and construction.

### Defining Green

These changes are seen as the first steps towards a greener BC Building Code, defined in changes to Division A with the addition of the following objective:

**OE Energy and Water Efficiency**

**An objective of this Code is to limit the probability that, as a result of design, construction or renovation of a *building*, the use of energy or water will be unacceptably inefficient or the production of greenhouse gases will be unacceptably excessive.**

### Effective Date

The new green requirements in the BC Building Code will apply to building permit applications submitted on or after September 5, 2008. These first steps will be followed by additional changes to the Code to reduce the environmental footprint of buildings throughout their lifespan.

Areas under exploration include greywater recycling, the use of lighting sensors and the reuse of existing buildings, and will involve further consultation with local governments, industry and the public.

### The New Requirements

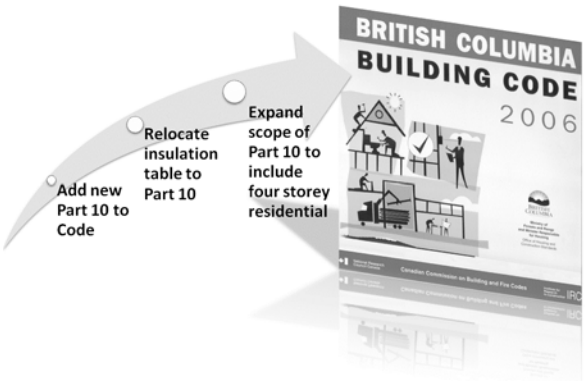
- Energy Efficiency Requirements for Single Family Houses and Smaller Multi-Family Residential, Commercial and Industrial Buildings
  - Insulation standards for houses and multi-family residential buildings under five storeys have changed. There are new insulation standards for small commercial and industrial buildings
  - For housing, builders can choose to achieve an EnerGuide rating of 77 as an alternative to meeting the insulation requirements, and
  - A further alternate for housing is the use of computer modeling resulting in equivalent performance to the prescriptive insulation standards.
- Energy Efficiency Requirements for High-Rise Multi-Family Residential and Larger Industrial, Commercial and Institutional Buildings
  - Larger buildings must meet the American Society of Heating, Refrigeration and Air-Conditioning Engineers 90.1 (2004) standard. ASHRAE 90.1 is an internationally recognized consensus standard for energy efficiency in buildings.
- Water Efficiency Requirements
  - Ultra low-flow toilets (6 L) and other water-saving plumbing fixtures will become mandatory in new construction and renovations.

The new requirements and specific Code changes can be viewed at www.housing.gov.bc.ca/building/green.

## Changes in the BC Code

The Code will now contain a new, Part 10 that reflects the two new added objectives of water and energy efficiency. The Part 9 thermal insulation table has been relocated to Part 10 and its scope has been expanded to include four storey residential buildings.

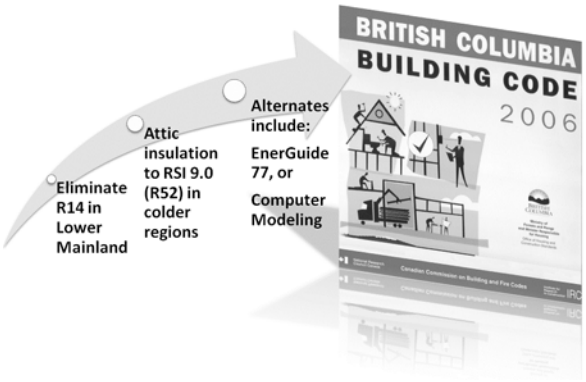
*Figure 1: The addition of Part 10 to the Code*




The table has further been amended by:

- Eliminating the allowance to use R14 instead of R20 insulation for natural gas-heated buildings in the Lower Mainland, and
- Increasing the attic space insulation from RSI 7.7 (R44) to RSI 9.0 (R52) in the colder areas of the Province (greater than 4500 degree days).

*Figure 2: Insulation changes and EnerGuide*




Achievement of an EnerGuide for New Houses Rating of 77 is an acceptable solution that provides an alternative to compliance with the insulation table for residential buildings.

Non-residential Part 9 buildings must now provide thermal insulation in wall, roof and suspended floor assemblies. The amount of insulation is derived from ASHRAE 90.1 (2004). All other buildings (primarily Part 3) must comply with the ASHRAE 90.1 (2004) standard.

The requirements of the existing Water Conservation Plumbing Regulation have been relocated to Part 10 of the Building Code and are now applicable province-wide.

*Figure 3: Large building and water conservation*


## Residential Under Five Storeys - Insulation

The table of insulation values from Part 9 of the 2006 Code has been moved to the new Part 10 as Table 10.2.1.1 A. The table has also been revised to include residential frame construction below five storeys.

There are now three climate zones, each having prescriptive insulation values for attics, walls, suspended floors, foundation walls, concrete slabs and radiant heated floors that separate heated space above and below. This has changed from two climate zones in the current Code. A map showing the approximate climate zones and the impact of the changes in each zone is provided on page 5.

*Figure 4: Climate zones for insulation values of residential frame construction less than five storeys*


LEGEND

- The darker shaded regions represent communities with greater than 4500 degree days (below 18 degrees C), and the requirements for insulation are RSI 9.0 (R52) for the attic and RSI 3.85 (R22) for the walls.
- The medium shaded regions represent communities with between 3500 and 4500 degree days, and the requirements for insulation are RSI 7.7 (R44) for the attic and RSI 3.5 (R20) for the walls.
- The lighter shaded regions represent the communities with less than 3500 degree days, and the requirements for insulation are RSI 7.0 (R40) for the attic and RSI 3.5 (R20) for the walls.

It is important to note that the reference in the existing Code for reducing (for one meter at the perimeter) the value of the insulation of the attic to not less than that of the walls has been moved to a footnote in the table for the new Part 10 of the Code. The allowable perimeter attic insulation reduction is now 1 meter for up to 4500 degree days, and 1.5 meters for the communities with greater than 4500 degree days (denoted by the darkest regions in the map of BC shown above).

The table showing the specific values appears on page 6 and is also available at: www.housing.gov.bc.ca/building/green.

*Figure 5: Part 10 table of residential insulation values*

**Table 10.2.1.1. A.**
**Minimum Thermal Resistance of Insulation RSI, m2°C/W for *Buildings* of *Residential Occupancy* less than 5 Storeys in *Building Height***
Forming Part of Sentence 10.2.1.1.(2)

| ***Building* Assembly** | **Value Required** | **Value Required** | **Value Required** |
|---|---|---|---|
| | **Less than 3500 Degree Days** | **3500 Degree to 4500 Degree Days** | **More than 4500 Degree Days** |
| Attic Space(1) | 7.0 | 7.7 | 9.0 |
| Roof Joist Assemblies (Cathedral Ceilings/Flat Roofs) | 4.9 | 4.9 | 4.9 |
| Frame Walls(2) (including frame crawl space walls) | 3.5 | 3.5 | 3.85 |
| Suspended Floors (framed) | 4.9 | 4.9 | 4.9 |
| Suspended Floors (concrete slab) | 2.1 | 2.1 | 2.1 |
| Foundation Walls (insulation to 600 mm below grade) | 2.1 | 2.1 | 2.1 |
| Unheated Concrete Slabs on Ground at or above grade (insulation around edge of slab(3) and 500mm vertical or horizontal from bottom edge of slab) | 1.8 | 2.1 | 2.1 |
| Radiant Heating Slabs on Ground (insulation under all slab area and around edge of slab) | 2.1 | 2.1 | 2.1 |
| Radiant Heating Suspended Floor Assembly Over Heated Area (insulation between heated floor and heated area below) (4) | 2.1 | 2.1 | 2.1 |

(1) The thermal resistance rating of attic space insulation may be reduced for a distance of
(a) 1.0 m from the exterior wall in *buildings* where the thermal resistance rating of the wall below is not required to exceed 3.5 or
(b) 1.5 m from the exterior wall in *buildings* where the thermal resistance rating of the wall below is not required to exceed 3.85.

(2) Stud/Frame type wall construction. This is not intended to apply to masonry, log or construction without a cavity.

(3) The top edge of insulation between the slab edge and foundation wall may be protected with a pressure treated preserved wood filler strip not more than 50 mm thick.

(4) Not applicable when heating elements or piping are located within a concrete topping on a suspended floor assembly or within an internally heated suspended slab.

## Non-Residential – Insulation

Buildings with occupancy other than residential as described in Sentence 1.3.3.3(1) Division A of the Code will reference the new Table 10.2.1.1. B in Part 10 of the Code. This table is derived from ASHRAE 90.1 and it is important to note that the climate zones for this table are different from those used for residential occupancy. These three climate zones are defined as: less than 4000, 4000 to 5000, and greater than 5000 degree days. There is no accommodation for reducing insulation values at the perimeter of the attic for buildings of this type.

*Figure 6: Part 10 table of non-residential insulation values*

**Table 10.2.1.1.B.**
**Minimum Thermal Resistance of Insulation RSI, m2°C/W for *Buildings* of other than *Residential Occupancy* as described in Sentence 1.3.3.3(1) Division A**
(Derived from ANSI/ASHRAE/IESNA Standard 90.1)

| ***Building* Assembly** | **Value Required** | | **Value Required** | | **Value Required** | |
|---|---|---|---|---|---|---|
| | **Less than 4000 Degree Days** | | **4000 to 5000 Degree Days** | | **Greater than 5000 Degree Days** | |
| | Heated | Semi heated (1) | Heated | Semi heated (1) | Heated | Semi heated (1) |
| **Roof Insulation** above deck | 2.6 ci | 0.9 ci | 2.6 ci | 0.9 ci | 2.6 ci | 0.9 ci |
| Metal building (2) | 3.3 | 1.8 | 3.3 | 1.8 | 3.3 | 1.8 |
| Attic or other | 5.3 | 3.3 | 6.7 | 3.3 | 6.7 | 3.3 |
| **Walls, Above Ground** | | | | | | |
| Mass | 1.3 ci | - | 1.7 ci | - | 2.0 ci | - |
| Metal building *(2)* | 2.3 | 1.9 | 2.3 | 2.3 | 2.3+2.3(3) | 2.3 |
| Steel Framed (4) | 2.3+0.7 ci | 2.3 | 2.3+0.7 ci | 2.3 | 2.3+1.3 ci | 2.3 |
| Wood Frame or other | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| **Suspended Floors** | | | | | | |
| Framed | 5.3 | 2.3 | 5.3 | 2.3 | 5.3 | 3.3 |
| Concrete slab | 1.5 | - | 1.5 | - | 1.5 | 0.7 ci |

**Notes**

ci continuous insulation: insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior, exterior or is integral to any opaque surface of the *building* envelope.

(1) Semiheated space is an enclosed space within a *building* that is heated by a heating system greater or equal to 10W/m$^2$ of floor area but does not exceed:
a) 45 W/m$^2$ of floor area in locations of less than 4000 degree days, or
b) 60 W/m$^2$ of floor area in locations of 4000 or greater degree days

(2) a *building* constructed primarily of a steel framed superstructure and metal skin

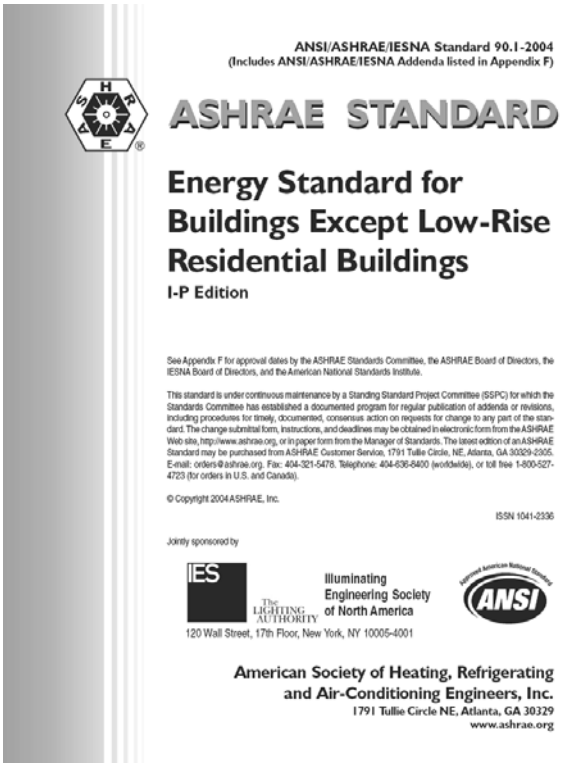
(3) the first rated R-value is the insulation compressed between metal wall panels and the steel structure the second rated R-value is for insulation installed from the inside, covering the girts

(4) a wall with a cavity (insulated or otherwise) whose exterior surfaces are separated by steel framing members (i.e.typical steel stud walls and curtain wall systems.)

## Part 3 Buildings (Excluding Residential Under Five Storeys)

For those structures generally described as Part 3 buildings (excluding all residential buildings under five storeys), the new requirement under Part 10 of the Code is to comply with ASHRAE 90.1 (2004). This consensus standard offers design professionals a choice to explore prescriptive, building envelope trade-offs or energy cost modeling methods for the design of buildings. The standard focuses on supporting the construction of buildings that balance mechanical and building envelope solutions, resulting in effective, efficient construction and operation.

*Figure 7: ASHRAE 90.1 (2004)*



ANSI/ASHRAE/IESNA Standard 90.1-2004
(Includes ANSI/ASHRAE/IESNA Addenda listed in Appendix F)

ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition

See Appendix F for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the IESNA Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site, http://www.ashrae.org, or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in U.S. and Canada).



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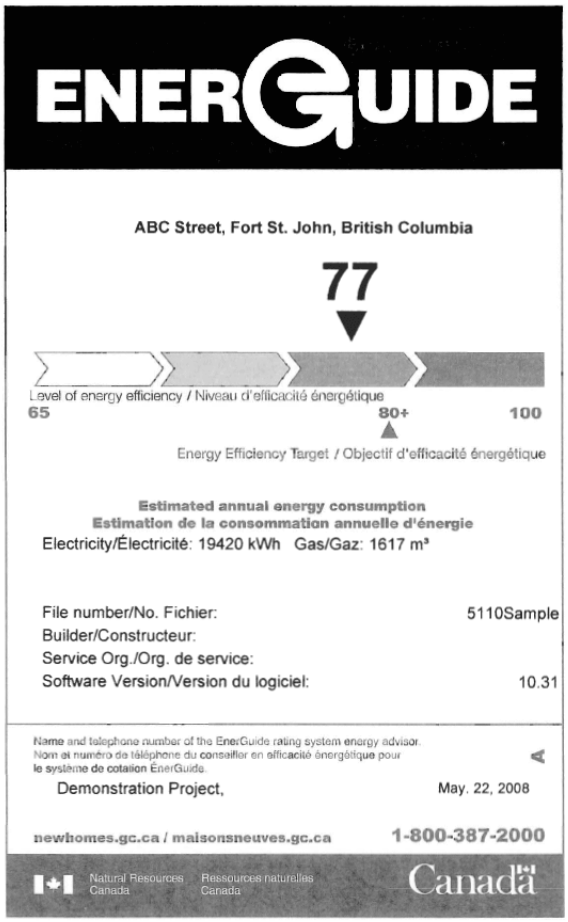
## Alternative Approach to Insulation Requirements Using EnerGuide

An alternative to the prescriptive requirements for residential insulation is to design and construct a building that achieves an EnerGuide for New Houses rating of at least 77. To build an EnerGuide rated house, builders must employ the services of a Certified Energy Advisor to undertake a design review and provide assistance in determining any design changes that will achieve a minimum 77 rating. When the building envelope is complete, a door fan test must be undertaken to determine the constructed air tightness of the building. Successful test results then allow the energy advisor to complete the application for the certification of the building and for the production of the rating label which is then applied on or near the electrical panel. Builders who opt for the EnerGuide approach may be required to provide additional documentation in order to obtain a building or occupancy permit.

*Figure 8: Sample label for EnerGuide home*



ENERGUIDE

ABC Street, Fort St. John, British Columbia

77

Level of energy efficiency / Niveau d'efficacité énergétique
65 80+ 100

Energy Efficiency Target / Objectif d'efficacité énergétique

Estimated annual energy consumption
Estimation de la consommation annuelle d'énergie
Electricity/Électricité: 19420 kWh Gas/Gaz: 1617 m³

File number/No. Fichier: 5110Sample
Builder/Constructeur:
Service Org./Org. de service:
Software Version/Version du logiciel: 10.31

Name and telephone number of the EnerGuide rating system energy advisor.
Nom et numéro de téléphone du conseiller en efficacité énergétique pour le système de cotation ÉnerGuide.
Demonstration Project, May. 22, 2008

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## Water Efficiency Regulations

The existing Water Conservation Plumbing Regulation in force in some jurisdictions throughout British Columbia has been included in Part 10 and now applies to all buildings in BC. The table identifying the flow restriction rates is included on page 8.

*Figure 9: Water faucet flow limits*

| Table 10.3.1.1. Maximum Flow Rates for Supply Fittings Forming Part of Sentence 10.3.1.1.(1) | | |
|---|---|---|
| **Fittings** | **Maximum Flow (L/min)** | **Test Pressure (kPa)** |
| Lavatory Faucet | 8.3 | 415 |
| Kitchen Faucet | 8.3 | 415 |
| Shower Head | 9.5 | 550 |

| Table 10.3.1.2. Maximum Flush Cycle Forming Part of Sentence 10.3.1.2.(1) | |
|---|---|
| **Fixture** | **Litres** |
| Water Closet (Tank Type) | 6.0 |
| Water Closet (Direct Flush) | 6.0 |
| Urinal (Tank Type) Urinal (Direct Flush) | 5.7 |
| | 5.7 |

## Impact of the Changes

### Case Study of Sample Home

A home design used throughout British Columbia was used as a costing base for the examination of the impact of the new energy efficiency requirements. The energy efficiency regulations are made under the Energy Efficiency Act. The home design, reproduced in part with the copyright permission of Select Home Designs, was chosen to reflect a basic construction that could be built in most regions of the Province and the impact was examined for five cities.

*Figure 10: Sample home (Copyright Select Home Designs)*

The base home was specified with 2 x 6 wall construction with Code minimum insulation for the region (2006 BC Building Code). It contained raised heel trusses, batt insulation in the walls and blown in place insulation in the attic. The crawlspace had R12 rigid insulation on the foundation wall to 600 mm below grade and the spec included a 92% AFUE high efficiency gas furnace, sealed, double glazed vinyl frame windows with low e and insulated spacers, and an induced draft 40 gallon hot water heater. It is important to note that actual construction practices may significantly exceed the minimum required by Code and this will result in lower (possibly significantly lower) construction costs to achieve an EnerGuide 77 or greater rating than those presented on pages 9 and 10.

*Figure 11: Main floor plan of sample house (Copyright Select Home Designs)*

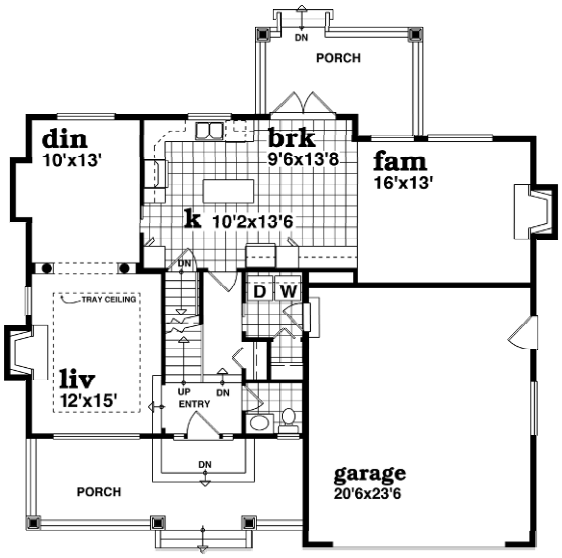
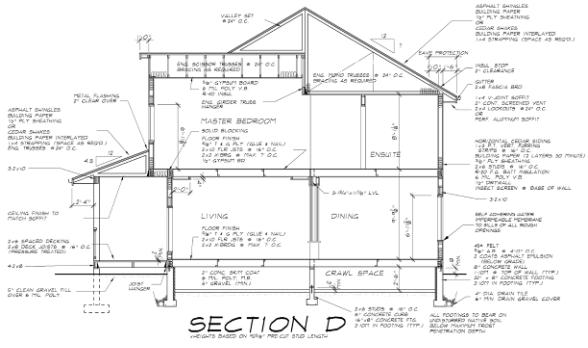



*Figure 12: Section through sample house (Copyright Select Home Designs)*




The case study considered this home in Fort St John, Castlegar, Penticton, Nanaimo and Vancouver.

## Fort St John

The base house constructed to the requirements of the 2006 BC Building Code was given an EnerGuide for New Houses (EG) rating of 68. The following shows the revised EG rating and cost premium for the minimum requirements as of September 5, 2008. It also shows the revised EG rating and cost premium for converting to ½-pound spray foam insulation, 2-pound spray foam insulation, for adding 1 1/2" of rigid insulated sheathing to the exterior of the batt insulated wall, and for the most efficient upgrade and premium for achieving a minimum EnerGuide 77 rating on the house.

*Figure 13: ½-pound spray foam application*

From 2006 Base House (EG 68)

| | |
|---|---|
| To Sept 5 (EG 69) | $ 447 |
| To ½ pound (EG 69) | $16,278 |
| To 2 pound (EG 69) | $37,734 |
| To ext. rigid (EG 70) | $12,160 |
| EnerGuide 77 | $21,108 |

To achieve this EG 77 rating, it was recommended to downgrade the insulation from R22 to R20 in the walls, from R44 to R40 in the attic, to add sealed, triple glazed, low e, argon filled windows (with insulated spacers) and to add an Air Source Heat Pump (ASHP) over a high efficiency single stage natural gas furnace (for supplemental heat).

## Castlegar

The base house constructed to the requirements of the 2006 BC Building Code was given an EnerGuide for New Houses (EG) rating of 72. The following shows the revised EG rating and cost premium for the minimum requirements as of September 5, 2008.

From 2006 Base House (EG 72)

| | |
|---|---|
| To Sept 5 (EG 73) | $ 35 |
| To ½ pound (EG 73) | $14,925 |
| To 2 pound (EG 73) | $31,623 |
| To ext. rigid (EG 75) | $ 5,748 |
| EnerGuide 81 | $12,243 |

To achieve this EG 81 rating, it was recommended to upgrade the insulation from R20 to R22 in the walls, and to add an Air Source Heat Pump (ASHP) over an electric furnace (for supplemental heat). It would have been approximately the same cost to use alternate methods of achieving an EG rating of 77 (by changing other building envelope systems) as it cost to achieve an EG rating of 81 with the heat pump. The added return on operating efficiency of the higher EG rating combined with the benefit of having summer cooling with the mechanical upgrade influenced this recommendation.

## Penticton

The base house constructed to the requirements of the 2006 BC Building Code was given an EnerGuide for New Houses (EG) rating of 73. The following shows the revised EG rating and cost premium for the minimum requirements as of September 5, 2008.

From 2006 Base House (EG 73)

| | |
|---|---|
| To Sept 5 (EG 73) | $ 0 |
| To ½ pound (EG 73) | $13,673 |
| To 2 pound (EG 73) | $25,201 |
| To ext. rigid (EG 76) | $ 4,778 |
| EnerGuide 82 | $10,235 |

To achieve this EG 82 rating, it was recommended to upgrade the insulation from R20 to R22 in the walls, and to upgrade the insulation in the ceiling to R44 along with the addition of an Air Source Heat Pump (ASHP) over an electric furnace (for supplemental heat). It would have been approximately the same cost to use alternate methods of achieving an EG of 77 (by changing other building envelope systems) as it cost to achieve an EG rating of 82 with the heat pump. The added return on operating efficiency of

the higher EG rating combined with the benefit of having summer cooling with the mechanical upgrade influenced this recommendation.

## Nanaimo

The base house constructed to the requirements of the 2006 BC Building Code was given an EnerGuide for New Houses (EG) rating of 75. The following shows the revised EG rating and cost premium for the minimum requirements as of September 5, 2008.

From 2006 Base House (EG 75)

| | |
|---|---|
| To Sept 5 (EG 75) | $ 0 |
| To ½ pound (EG 75) | $15,136 |
| To 2 pound (EG 75) | $28,153 |
| To ext. rigid (EG 76) | $ 4,716 |
| EnerGuide 77 | $ 1,491 |

To achieve this EG 77 rating, it was recommended to upgrade the insulation from R20 to R22 in the walls, and to upgrade to a tankless demand domestic hot water system.

## Vancouver

The base house constructed to the requirements of the 2006 BC Building Code was given an EnerGuide for New Houses (EG) rating of 73. The following shows the revised EG rating and cost premium for the minimum requirements as of September 5, 2008.

From 2006 Base House (EG 73)

| | |
|---|---|
| To Sept 5 (EG 75) | $ 694 |
| To ½ pound (EG 75) | $13,477 |
| To 2 pound (EG 75) | $25,210 |
| To ext. rigid (EG 76) | $ 4,508 |
| EnerGuide 77 | $ 2,161 |

To achieve this EG 77 rating, it was recommended to upgrade the insulation from R20 to R22 in the walls, and to upgrade to a tankless demand domestic hot water system.

The findings of this case study underscored the variety of options that can impact the energy performance of a home and how the different climate regions throughout the province have unique conditions that will influence the final design and construction methods.