The EnerGuide for Houses Program
A Successful Canadian Home Energy Rating System

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ABSTRACT

The EnerGuide for Houses Program (EGH) is an initiative of the federal department of Natural Resources Canada (NRCan) to promote energy efficiency retrofits in existing houses. The Program is based on the concepts of the home energy rating system, and was launched in April 1998 across Canada.

Prior to the launch, NRCan spent significant efforts in the design of the program, development of technical guidelines, audit procedures, energy evaluation software and homeowner reports, program implementation and tracking procedures, quality control procedures, auditor training courses, and, most importantly, pilot testing in three distinct housing markets. The pilot testing proved to be an invaluable field experience for trouble-free implementation of the EnerGuide for Houses Program.

The EGH evaluator investigates the energy related features of a house, estimates the home's annual energy requirements, provides a comparative energy efficiency rating and provides a comprehensive report including recommended retrofits. Once a homeowner implements retrofits, a second EGH evaluation is performed to update the energy efficiency rating.

The Program is implemented on the basis of co-operation between the private and public sectors. NRCan is primarily providing assessment tools, training programs for auditors, marketing resources and technical support to a number of private, public and voluntary sectors delivery agents located in each region of the country. Delivery agents market the program and sell EGH audits to homeowners in their designated territories (price ranging from C$0 to C$150 per audit) and assume associated liability risks. Additionally, NRCan buys the house data from delivery agents for a fixed price of C$150 per energy evaluation.

Since the Program launch to the end of April 2000, over 14,000 houses have been rated across Canada of which about 1,115 houses have been re-evaluated after homeowners implemented energy efficiency retrofits. On average, energy evaluations recommended measures that are expected to reduce energy consumption by 20 to 25%. Customers installed about 2/3rd of recommended measures resulting in the reduction of energy use by 10% to 15% annually in houses which were retrofitted. However, in a follow-up survey conducted as part of the Quality Assurance process for EGH, 70% of homeowners said that they implemented one or more of the recommended retrofits but for a variety of reasons, had not bothered with a post-improvement evaluation.

Introduction

Canadians use significant amounts of energy to heat, cool and ventilate their homes, operate lights and appliances and heat domestic hot water. According to the latest data available for 1998, the residential energy use was 1,385 petajoules (1 PJ = 10^{15} J) which accounted for 17.8% of secondary energy use in Canada. Due to inclement cold climate, space and domestic water heating energy requirements account for over 82% of residential energy demand in most regions. Residential sector-

related carbon dioxide emissions were 69 megatonnes, which represented 16% of secondary energy-related emissions (OEE 2000). Improvement in the energy efficiency of dwellings is, therefore, a focus of federal government agencies interested in reducing carbon dioxide emissions.

It is also interesting to note that residential renovation and repair is a common activity in Canada. Consumer surveys conducted in 1992 and 1996 have determined that 47% of Canadian households undertook at least one interior project and 32% did at least one exterior project during each year (IEML). The total amount spent on housing renovation in 1998 was estimated to be C$19.7 billion, an amount comparable to that spent on the new construction (CMHC 1999). Data on 1999 spending is expected to be available from CMHC and Statistics Canada during the fall of 2000; however, the projected estimate for 1999 is about C$21 billion.

This large and well-developed home retrofit and renovation market provides a significant opportunity for promoting energy-efficiency-related upgrades. Energy efficiency retrofits included with common renovation practices would reduce the first costs associated with upgrades. For example, every year about 168,000 existing houses replace or upgrade space-heating equipment (furnace or boiler). By piggy-backing on the base cost associated with the equipment, the incremental cost associated with high-efficiency equipment relative to a commonly available mid-efficiency equipment can then be recouped in a reasonable period of about 5 years.

The Program is an initiative of the Office of Energy Efficiency of Natural Resources Canada (NRCan) that has a mandate to promote energy efficiency to reduce the environmental impact of energy use. To achieve this mandate, NRCan delivers energy efficiency programs targeted at all sectors of the economy, including the residential sector. Several NRCan programs improve the energy efficiency of new houses (R-2000), regulate minimum energy performance standards for certain household equipment (EnerGuide under the Energy Efficiency Act and Regulations), and encourage Canadians to upgrade the energy efficiency of existing homes (EnerGuide for Houses).

This paper describes the EnerGuide for Houses' program design aspects, technical guidelines, assessment and rating tools, quality control procedures and implementation methods. The paper also briefly summarizes the data analyses to show potential for savings in energy end-use and reductions in greenhouse gases.

Background

In 1993, Natural Resources Canada (NRCan), Canada Mortgage and Housing Corporation (CMHC), several provincial energy agencies and electric utilities undertook a comprehensive assessment of the status of home energy retrofits. These consultations led to the development of Retrofit Options Report (NRCan 1993). One of the major options recommended was to develop Canadian Voluntary Home Energy Rating System (CV-HERS).

NRCan took the lead in the development of the groundwork for voluntary procedures for home energy ratings. Initial consultations with various stakeholders (utilities, provincial energy and housing ministries, trade associations, utilities, financial institutions, consumer and real estate associations and so on) raised a number of issues which further helped in shaping the development of uniform rating procedures. NRCan also consulted with the US Home Energy Rating Systems Council (US-HERS) and reviewed various implementation models. In this process several voluntary committees were formed to guide the development of uniform energy rating procedure. Members of the voluntary committees were selected for their expertise in home energy audits, energy rating systems, demand-side management programs, retrofit/renovation trades, and experience in other industries involved in residential energy efficiency, as well as for the various points of view they represent. The guiding theme was that the rating procedure should: encourage uniformity and consistency across different climate regions; identify levels of efficiency and suitable energy retrofit

measures; be responsive to advances in building science and energy efficiency technology; and above all, be workable, easy to implement, inexpensive and clear to the homeowner.

During 1995 to 1997, NRCan developed a number of drafts of rating procedures and assessment tools, and pilot-tested these procedures in three regions. The pilot testing in about 350 houses provided valuable and excellent 'learning' which later on assisted in refining the home energy rating system implementation model as well as field assessment tools.

Prior to the launch of the Program, NRCan spent significant efforts in the overall design of the program, technical guidelines, audit procedures, energy evaluation software, homeowner reports, program implementation and tracking procedures, quality control procedures and auditor training courses.

One of the main issues was the name of the Program – Canadian Voluntary Home Energy Rating System (CV-HERS). A limited market survey and discussions with regional consultants who participated in pilot testing found that the 'CV-HERS' was seemed to be a barrier in selling the rating procedure to homeowners. After a number of consultations with various stakeholders, NRCan proposed to change the name to EnerGuide for Houses Program. 'EnerGuide' is an official mark of the Natural Resources Canada and has been in use for almost two decades for promoting energy efficient appliances such as refrigerators, washers, dryers, air-conditioners, fuel-economy of automobiles and so on. 'EnerGuide' mark has an excellent brand-name reputation with homeowners. 'EnerGuide' is well suited for energy efficiency rating of houses.

Since the Program was launched in April 1998 across Canada, 14,013 houses have been rated across Canada of which about 1,115 houses have been re-evaluated after homeowners implemented energy efficiency retrofits. The implementation procedures, technical guidelines and house evaluation tools have undergone a second stage of revisions in September 1999 to improve the energy consumption estimates and ease the implementation process. NRCan forecasts that over 10,000 houses will be evaluated every year for the next four years.

The EnerGuide for Houses Program

The EnerGuide for Houses rating system is based on the principles of the home energy rating system. The rating system provides a reliable and objective tool for assessing the energy performance of a house, and can help energy efficiency evaluators and homeowners identify strategies to improve a house's energy efficiency. The rating can also be used to compare the performance of similar size houses built in similar climate regions. The main objectives are to:

- raise consumer awareness about the benefits of energy efficiency, such as energy-cost savings, improved home comfort and indoor air quality, and increased durability and resale value of new and existing homes;
- identify and prioritize energy efficiency upgrades, giving homeowners the facts needed to make informed decisions;
- serve as a marketing tool for promoting energy efficiency upgrades, and enhance the credibility and professionalism of the renovation industry;
- stimulate continued growth in the home renovation industry and increase demand for services and new energy-efficient products which in turn will result in job creation;
- provide financial institutions with a recognized and objective rating of home's annual energy consumption; and
- quantify and verify actual home energy improvements, for statistical and program design and evaluation purposes.

The EGH evaluator investigates the energy related features of a house, estimates the home's annual energy requirements, provides a comparative energy efficiency rating and provides a

comprehensive report including recommended retrofits. Once a homeowner implements retrofits, a second EGH evaluation can be performed to update the energy rating.

EnerGuide for Houses is based on the principle of a "house as a system." This principle recognizes that a change made to one component of a house can affect other components and that the comfort, health and safety of occupants, as well as the long-term integrity of the structure, must be primary considerations in housing construction or renovation.

The EnerGuide for Houses evaluation differs significantly from a home inspection. Generally, a home inspection involves a thorough examination on behalf of the purchaser or seller of the overall physical condition of the house including necessary upgrades and repairs. This inspection does not usually include a detailed analysis of the house's energy performance or recommend energy efficiency improvements. EnerGuide for Houses, on the other hand, evaluates the home's annual energy requirements and provides a comparative energy efficiency rating. An EnerGuide for Houses evaluation focuses on how the home's energy performance can be improved while maintaining or improving indoor environmental conditions. The EnerGuide for Houses evaluation produces a label with energy use and an energy efficiency rating of a house, while a thorough and detailed homeowner's report recommends appropriate energy efficiency retrofits and measures to improve the indoor air quality and comfort.

Acceptable indoor air quality is an overriding concern. For this reason, minimum ventilation rates are recommended, and no benefit is allowed in the rating system for having a poorly ventilated but well insulated home. The need for proper ventilation is recommended as part of the house audit.

Components of EnerGuide for Houses Program

The EnerGuide for Houses Program (EGH) developed the following well-defined components to provide uniformity in the delivery of energy ratings of houses:

- Administrative Procedures
- Technical Guidelines
- Evaluation Procedures
- Quality Assurance Procedures
- The Certification Process and Energy Efficiency Rating Label
- Code of Ethics
- Evaluator Workshop Manual
- EnerGuide for Houses Database

The Administrative Procedures

The Administrative Procedures provide a framework for good business practices in the residential construction/renovation industry. The EnerGuide for Houses delivery framework identifies all target audiences as being key players in the program. NRCan coordinates and manages the EnerGuide for Houses Program at the national level. NRCan also recruits delivery agents to implement the Program using the nation-wide open bidding system. A delivery agent is defined as any organization that implements and delivers the Program at the regional level. Delivery agents are responsible for recruiting, training and employing energy efficiency evaluators. The energy efficiency evaluators perform EGH audits and recommend improvements to the homeowner or builder. External influencers are a group of key players that, while not directly involved in the delivery of the Program, can influence the acceptance and understanding of the program among key target audiences. The real estate community, banks and financial institutions, retail organizations, public and private utilities and consumer advocate groups are all examples of external influencers.

The Technical Guidelines

The Technical Guidelines provide standardized rating procedures and support the development of energy efficiency evaluation tools and procedures.

The EGH Technical Guidelines are intended to provide fair assessment of various types of houses in different regions. Since the beginning, the Program has gained sufficient experience in different regions with regard to the effectiveness of the technical guidelines. The Technical Advisory Committee (TAC) for the EnerGuide for Houses program has met thrice since the Program was launched. This advisory committee recommended several practical approaches that have significantly eased the field assessment procedures.

Occupancy and Operating Conditions. The cornerstones of the EGH rating are the standard occupancy and operational conditions that used for energy efficiency evaluations. These occupancy and operating conditions were developed based on the data analyses of estimated and predicted energy use in more than 1,000 real houses and were tested extensively to show their significance (NRCan 1997a). The standard conditions are:

- four occupants (two adults and two children) present in the home 50 percent of the time;
- a thermostat setting of 21 $^{\circ}$C for main floors and 19 $^{\circ}$C for basement and storage rooms;
- consumption of 225 liters of domestic hot water per day;
- electricity consumption for lighting and appliance set at 24 kWh per day (31,536 MJ/year);
- a minimum total monthly average ventilation rate of 0.30 air changes per hour (ac/h) during the heating season (typically October through April), including both natural air leakage and mechanical ventilation; and
- EGH rating is estimated using the 30-year average weather data while the energy consumption for the house is estimated using the current or last year weather data.

Rating Calculations. NRCan developed an innovative EnerGuide Rating System. The rating parameters correlate to energy efficiency of houses and include the effects of size and location of houses and type of fuel use. The EnerGuide rating is normalized and is independent of the type of fuel used in a house. The rating system mainly deals with energy consumption for space heating. In Canada, the residential cooling load ranges from 2% to 5% of annual energy use, therefore, is not considered in the rating calculations. The rating system assumes pre-defined base loads for appliances and domestic hot water. The following procedure briefly explains various calculations to derive the EnerGuide Rating for a house (NRCan 1997b).

- The EnerGuide Rating is defined as,
  Energy Efficiency Rating   =   100 - ((Equivalent Total Energy Consumption / Reference Energy Consumption) * 20)

- The annual equivalent total energy consumption for a house is given by,
  Equivalent Total Energy Consumption =   Equivalent Space Heating Consumption + Equivalent Occupancy Consumption

  Equivalent Space Heating Consumption =   Space Heating Consumption * G_s
  where,
  $$Gs = 10*(S_E*B_{SE} + S_F*B_{SF})/(S_E + S_F)$$

  S_E is estimated space heating energy consumption due to electric, MJ
  S_F is estimated space heating energy consumption due to fossil fuels, MJ

B_{SE} is base efficiency of electric space heating equipment (100%)
B_{SF} is base efficiency of fossil fuel space heating equipment (80% AFUE)

Equivalent Occupancy Consumption   =   DHW Consumption * G_D + Lights and Appliances Consumption

where,

$$G_D = 1.136*(D_E*B_{DE} + D_F*B_{DF})/(D_E + D_F)$$

D_E is estimated domestic hot water energy consumption due to electric, MJ
D_F is estimated domestic hot water energy consumption due to fossil fuels, MJ
B_{DE} is base efficiency of electric DHW equipment (0.88 Energy Factor)
B_{DF} is base efficiency of fossil fuel DHW equipment (0.57 Energy Factor)

Lights and Appliances Consumption   =   31,536 MJ (or 24 kWh/day)

- The annual reference energy consumption for a house is given by,
  Reference Consumption   =   Space Heating Benchmark + DHW Benchmark + Base Load Benchmark

$$\text{Space Heating Benchmark} = 3.6*\left(\frac{60*Degree\_Days}{6000}\right)*\left(35+\frac{V}{2.5}\right)$$

where *Degree_Days* is the number of long term average degree days to 18 $^{\circ}$C base and *V* is the heated volume of the house in cubic meters.

$$\text{DHW Benchmark} = 1.136*17082*\frac{55-T_w}{(55-9.5)}$$

where *Tw* is an annual average local water mains or deep soil temperature in $^{\circ}$C.

Base Load Benchmark = 31,536 MJ

Typical EnerGuide Ratings. Houses are rated on a scale of zero to 100. A zero (0) on the scale represents an uncomfortable house that has major air leakage, no insulation and extremely high energy consumption. The lower limit is set at zero. At the other end of the scale, a 100 represents a house that is very well insulated, is airtight and requires no purchased energy (such as a solar-powered home). Houses with moderate air leakage and insulation in all exterior wall cavities will typically have a rating of over 50, while a super energy-efficient new house, such as R-2000, will typically have a rating of 80 or above. A house must be habitable to qualify for a rating number. Figure 1 shows a typical range of EGH ratings for different types of houses. The energy ratings do roughly correspond to electric or natural gas bills per square foot of house. Higher the rating, lower the annual energy bill.

For example, an actual 1970 built 2-storey house, located in Winnipeg showed significant energy improvements. This house had an energy rating of 55 and annual total bill of about C$2,130. The house was retrofitted using R-20 additional insulation in the attic, air-sealing measures (joist headers in the basement and window/door weatherstripping) and R-12 insulation batts to cover the top 2-foot portion of the basement wall. These measures reduced the annual energy bill by about C$360 and improved energy rating by 10 points to 65 points. The retrofit cost was about C$1,200.
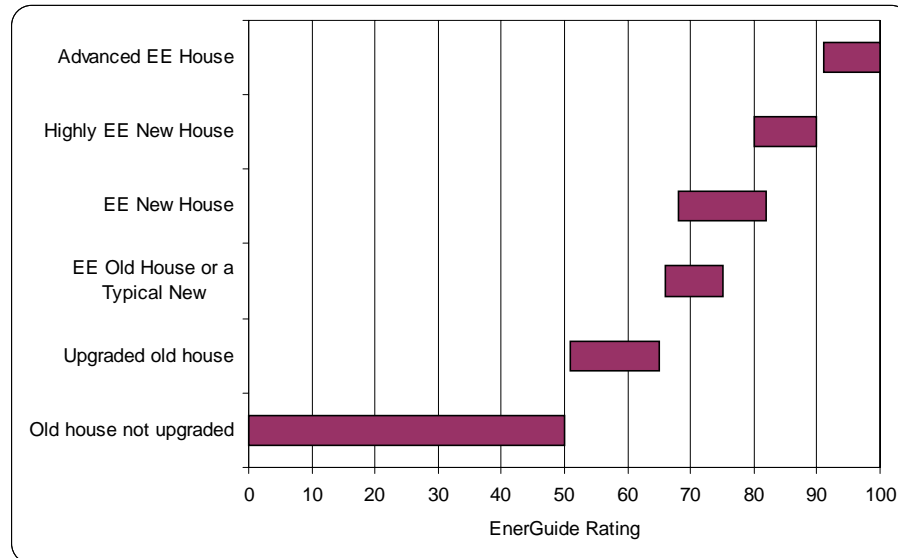
Figure 1. Typical EGH ratings for Canadian houses.

Comparison of EGH Rating Scale and US-HERS Designated Rating Method. The EGH rating method differs from the US-HERS designated rating method (Guidelines #12 of DOE 10 CFR Part 437). As shown in Table 1, one of the main differences is the specification of standard minimum ventilation rate for rating calculation. The need for minimum ventilation rate is effectively included in the EGH rating system.

The Evaluation Procedures

The Evaluation Procedures provide the field audit methods, standardized data collection forms including house observation checklist, software analysis tools, EGH rating label and homeowners report. Each house evaluation involves the following:

- *Pre-Evaluation Telephone Interview* – The energy evaluator gathers information about the home: number of occupants; existing problems; renovation plans; house description and year of construction; heating system and fuel bills.

- *On-Site House Evaluation* – The energy evaluator collects data on: building structure and site; building envelope; mechanical systems; building area and volume; building orientation; other relevant information; and also notes opportunities for energy savings, constraints to retrofit work, health and safety problems and structural concerns. The evaluator also performs a blower door test to check rate of air leakage as well as locate air leakage points with a smoke pencil and notes evidence of combustion spillage.

- *Energy Modeling and Analysis* – The evaluator makes use of the latest approved software to produce an accurate rating of clients' homes energy efficiency. Natural Resources Canada's CANMET Energy Technology Centre has applied over 15 years of innovation and energy analysis simulation research to develop the HOT2000 energy analysis software to support energy technicians on the job. The HOT2000 has been extensively validated using the field monitored data for houses as well as other software tools including the US HERS BESTEST. The software models the energy performance of the home based on standard operating conditions, assigns it an EnerGuide for Houses rating and generates a report that proposes a list of measures to reduce a home's energy consumption and costs (NRCan 1996). Energy evaluators generally do recommend measures to improve the energy efficiency and the indoor air quality.

Table 1. Comparison of EGH Rating Scale and the US-HERS Designated Rating Method

Items	US-Hers Rating Method	EGH Rating Method
Rating Scale		
Dimensionless rating score	Yes	Yes
Range of score	0 to 100 point	0 to 100 point
Rating of O indicates inefficiency	Yes	Yes
Rating of 100 indicates zero annual purchased energy for heating, cooling and water heating	Yes	Yes
Energy Loads		
Heating loads	Considered	Considered
Cooling loads	Considered	Not considered
Domestic hot water load	Considered	Considered
Rating is based on the comparison of each load with reference loads	Yes	Yes
Standard Operating Conditions		
Set-point temperature – heating	20 $^{\circ}$C	main floor 21 $^{\circ}$C, basement 19 $^{\circ}$C
Set-point temperature – cooling	25.6 $^{\circ}$C	None
Occupancy levels	Specified	Specified
Domestic hot water load	Specified	Specified
Appliances and base loads	Specified	Specified
Minimum ventilation rates	Not considered	Considered
Star Rating		
Five Star Plus or equivalent scale	Specified	Not specified

Questions are often asked about the relevancy and accuracy of the energy analysis predictions. During the pilot testing of the Program, NRCan evaluated and reconciled the utility bills for 35 houses to establish the level of confidence in the energy analysis estimates. It was found that the weather data, occupancy, and set-point temperatures significantly affected the energy estimates. Differences in actual and estimated energy use ranged from a meager 5% to a whopping 90%. To remedy these situations, two approaches were incorporated. The EGH Rating is generated using the 30-year average weather data and the standard occupancy and operating conditions described in the previous section. Secondly, the energy use estimates are determined using the last year's weather data, actual occupancy numbers and the observed set-point temperatures in the house. The homeowner report includes the energy use estimates and applicable recommendations for retrofits. An additional 15 house files were evaluated and reconciled with utility bills. The energy estimates from the rating are generally ranging from 5% to 20% of the observed energy use which is acceptable. Further impact evaluation is planned in the future.

- *Presentation of Report and Label* – The energy evaluator prepares a detailed report and guides homeowners through all aspects of the evaluation report. The evaluator also discusses recommended upgrades, energy cost and comfort benefits and explains the EnerGuide for Houses rating label.

Quality Assurance Protocol

In delivering the EnerGuide for Houses Program, NRCan's quality assurance goals are to (a) ensure that accurate and consistent energy efficiency evaluations are performed by knowledgeable energy efficiency evaluators and, (b) promote voluntary adherence to various procedures and objectives of the Program. To satisfy these goals, two approaches are implemented: (1) delivery agents periodically conduct random file reviews of houses that have been rated; and (2) NRCan conducts a detailed review of house data submitted. To date, the quality assurance reviews by

NRCan have involved about 4% of houses (close to 550). The overall review showed that QA has been effective in improving the quality of data and homeowner's upgrade recommendations. In a follow-up survey conducted as part of the Quality Assurance process for EGH, 70% of homeowners said that they implemented one or more of the recommended retrofits but for a variety of reasons, had not bothered with a post-improvement evaluation.

The EnerGuide for Houses Database

NRCan maintains a central database, with of records of each house with regard to its physical characteristics and energy use. The EGH database contains only the technical information on each house; records do not include names or street address in order to respect the privacy of the homeowner. Each delivery agent sends the electronic version of data files to the central EGH database through the internet. Each submitted file contains about 212 information fields. Each submitted file is also verified for quality of data before inclusion in the database. The EGH database also keeps track of payments to delivery agents. This database is currently accessible only by NRCan staff. The housing characteristics can be made available to others for further analysis.

Evaluator Workshop Manual

Delivery agents are responsible for recruiting, providing training workshops for, and certifying energy efficiency evaluators. NRCan provides the necessary training manuals, tools and training expertise. The training component covers some of the following aspects:

- a pre-qualification requirements for energy evaluator (such as the knowledge of building physics, residential HVAC equipment and so on)
- a basic primer on the EnerGuide for Houses Program
- a basic principles of heat transfer and the "house as a system" approach
- field training for performing energy evaluations
- instructions on using the evaluation software, conducting a blower door test and developing recommendations for energy efficiency improvements

EGH Delivery Costs

NRCan has developed a unique delivery model for the delivery of EnerGuide for Houses Program. Delivery agents invest in the infrastructure for the delivery of house audits. NRCan provides support for the rating procedures and tools, training of evaluators and marketing of EGH. NRCan only pays for the house data files submitted by delivery agent. For each acceptable house data file, NRCan pays about C$150 to the delivery agent. The delivery agents generally charge from C$0 to about C$150 to homeowners with an average of about C$50. In majority of cases, when the homeowner implements the recommended retrofits, the retrofit contractor generally pays for the second evaluation. In this way, the financial risk is reduced for the private sector delivery agents at the same time giving them an opportunity for developing a self-supporting business environment in the next five years.

Analysis of EGH Data Files

Since the inception of the EGH Program, as shown in Table 2, about 14,013 houses have been rated for energy efficiency across Canada of which about 1,115 houses have been re-evaluated after homeowners implemented energy efficiency retrofits. The data analysis presented in this section focuses on two major housing markets: Ontario and British Columbia. These two major markets have

provided more than 74% of total EGH evaluations. These two markets also represent about 48% of the 9.61 million Canadian housing stock comprising of single, semi-detached and row housing. The following summarizes predominant trends:

- The main target market for EGH Program is for existing homes built before 1985.
- Data analysis showed that houses that are 25 or more years of age tend to implement significant number of energy efficiency recommendations. Figure 2 shows the uptakes of measures in houses that were retrofitted.

Table 2. EGH evaluations.

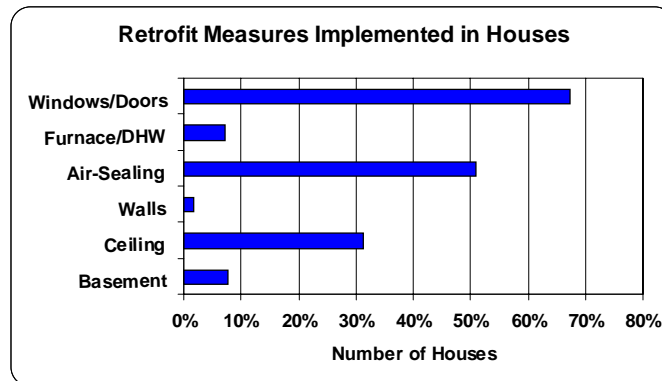| Province	Pre-Retrofit Evaluations	Post-Retrofit Evaluations
British Columbia	6,077	938
Alberta	1,616	5
Saskatchewan	531	1
Manitoba	709	19
Ontario	3,996	107
Quebec	409	2
New Brunswick	12	-
Nova Scotia	325	-
Newfoundland	58	31
PEI	6	-
Yukon	272	12
North West Territories	2	-
Total	**14,013**	**1,115**

Figure 2. Profile of retrofit measures installed in houses in BC and Ontario.
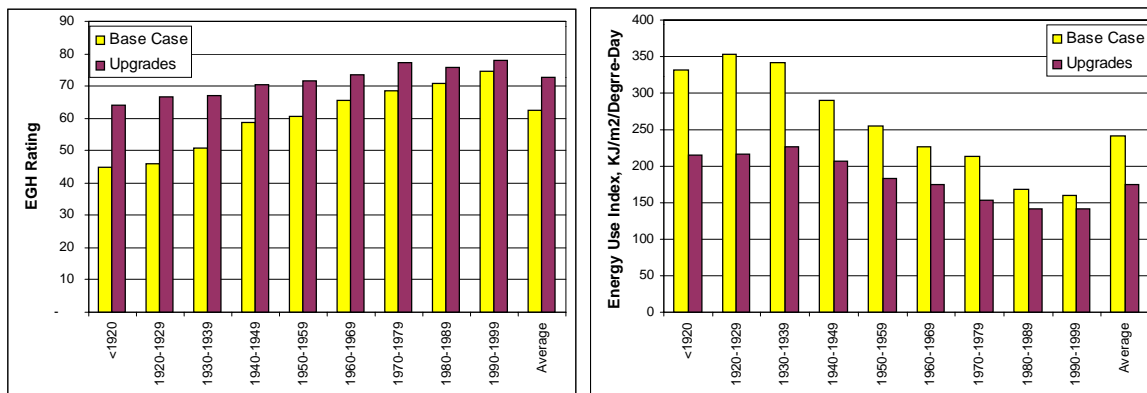

Figure 3. Average retrofit potential based on analysis of 3,996 houses in Ontario.

- Based on the analysis of 3,996 house audits, Figure 3 shows the average energy ratings and the energy use index for different age groups of houses in Ontario. The EGH rating for existing houses ranged from 0 to 83 points with an average of 63 points. Recommended energy efficiency measures could improve the EGH rating by about 10 points. This translates in an average reduction in annual energy consumption by about 24%.
- Based on the analysis of 6,077 house audits for British Columbia, the EGH rating for existing houses ranged from 0 to 79 points with an average of 36 points. Recommended energy efficiency measures could improve the EGH rating by about 9 points. This translates in an average reduction in annual energy consumption by about 21%.
- Based on the analysis of 938 houses audits, Figure 4 shows the energy ratings of houses which were retrofitted by homeowners in British Columbia. The EGH rating ranged from 29 to 70 points with an average of 53 points. Evaluators recommended measures to improve the EGH rating from 41 to 75 points with an average of about 64 points. The second EGH evaluation after the retrofits showed that the EGH rating improved from 39 to 76 points with an average of about 61 points. Data analysis showed that homeowners installed about 2/3rd of recommended measures.
- Based on the analysis of retrofitted houses in Ontario and B.C., the energy efficiency upgrades would reduce the GHG emissions from 0.5 to 6.0 tons/year/house with an average of about 2 tons/yr.
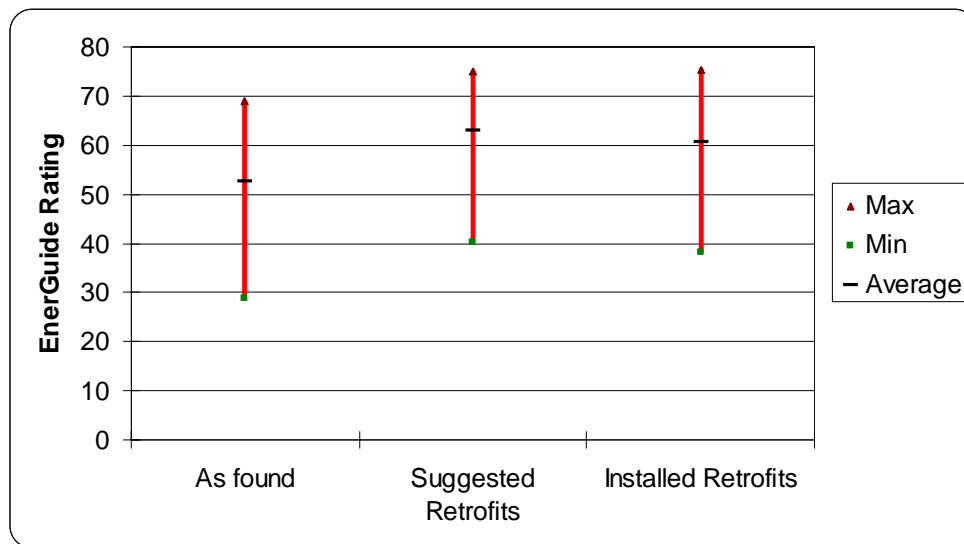

Figure 4. Analysis of 938 houses which were retrofitted in B.C.

Summary and Conclusions

The EGH program has a solid foundation to deliver home energy efficiency ratings and reliable retrofit advice to homeowners. Since it was launched, 14,013 houses have been rated across Canada of which about 1,115 houses have been re-evaluated after retrofits. The program is progressing successfully in facilitating the energy efficiency retrofits in Canada. NRCan forecasts that about 10,000 houses will be evaluated every year for the next four years. The following is a list of conclusions:

- The EnerGuide for Houses rating system is based on the principles of the home energy rating system. The EGH rating system differs from the US-HERS rating method specifically with regard to the inclusion of minimum ventilation requirements.

- The EGH rating method, evaluation procedures and house assessment tools seemed to work well in the marketplace. Continuous improvements are introduced to simplify the implementation of EGH rating system and also to improve the energy estimates. Independent evaluators / delivery agents deliver the EGH Program.
- The main goal of the EGH Program is to promote and entice homeowners to include energy efficiency improvements in their retrofit plans. The EGH rating is a tool, not an end product.
- Data analysis showed that about 82% of pre-retrofit EGH evaluations were for houses that were 15 or more years old. The post retrofits showed that homeowners inclined to implement retrofits in houses that are 20 or more years of age.
- On an average, energy evaluations recommended reductions in energy consumption by 20% to 25%. Average uptake rate is about $2/3^{rd}$ of recommended measures resulting in the reduction of energy use by 10% to 15% annually. The predicted reduction in annual energy bills ranged from C$75 to more than C$200 per house.
- Based on the analysis of retrofitted houses in Ontario and British Columbia, the energy efficiency upgrades would reduce the GHG emissions from 0.5 to 6.0 tons/year/house with an average of about 2 tons/yr.
- The EnerGuide for Houses program has raised the consumer awareness of the benefits of energy efficiency. Currently, about 1200 houses are being evaluated every month. The uptake rate for energy retrofits in evaluated houses is about 8%. However, in a follow-up survey conducted as part of the Quality Assurance process for EGH, 70% of homeowners said that they implemented one or more of the recommended retrofits but for a variety of reasons, had not bothered with a post-improvement evaluation. Generally, it takes about 6 months to two years for homeowner to implement some of the retrofit measures. It is expected that in next two years there will be good uptake of post-retrofit evaluations. NRCan is planning to conduct process and impact analyses of this program in the future.

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