

EnerGuide for Houses Retrofit Incentive Program: A Winning Strategy to Improve Energy Efficiency of Canadian Housing

*Diane Francoeur, Louise Roux and Anil Parekh
Natural Resources Canada*

ABSTRACT

The federal department of Natural Resources Canada initiated the EnerGuide for Houses (EGH) program in April 1998 to promote energy efficiency retrofits in existing low-rise houses. In October 2003, the federal government added an incentive component to the EGH program for homeowners.

The EGH concepts incorporate principles of the home energy rating system. House as a system approach is the basis for the energy efficiency evaluation of homes. The EGH advisor investigates the energy related features of a house, estimates the home's annual energy requirements, and provides a comparative energy efficiency rating as well as providing a comprehensive report including recommended retrofits. Once a homeowner implements retrofits, a second EGH evaluation is performed to measure improvement in energy efficiency. This difference in the pre- and post-renovation rating, an indicator of the improvement in energy efficiency, is the basis for the incentive.

The program is delivered on the basis of co-operation between the private and public sectors. Natural Resources Canada is primarily providing the assessment tools, the training program for energy advisors, marketing resources and technical support to the contractors. EGH contractors sell the evaluation service to homeowners in their designated territories and assume associated risks. Natural Resources Canada then buys the house data from the contractors for a fee of about C\$150 per energy evaluation.

Since the program launch to the end of April 2006, over 252,000 houses (about 3.1% of the eligible housing stock across Canada) have received the initial rating. Currently, EGH evaluations are performed at a rate of about 7,000 houses per month. Typically, homeowners implement about two thirds of recommended measures. On average, the homeowner retrofit incentive is C\$735 – which represents approximately 10% of the total retrofit costs. The success of the EGH and its incentive program has also influenced various utility and provincial government agencies to work together. These groups offer a matching incentive to the homeowner creating a winning strategy for promoting energy efficiency in existing houses.

Update: As part of a recent decision of the Government of Canada to reassess its climate change programs, the EGHRI program is being wound down in 2006-07. Pre-retrofit EnerGuide for Houses evaluations are no longer accepted as of May 13, 2006. Post-retrofit evaluations and grants will be funded until March 31st, 2007 at which time the program will be completed. This paper was completed before the program termination announcement.

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 the end of the year 2003, the residential energy use was 1,457 petajoules (1 PJ = 10¹⁵ J)

which accounted for 17.2% of total secondary energy use in Canada. Due to the cold climate, space and domestic water heating energy requirements account for over 78% of residential energy demand in most regions. Residential sector-related carbon dioxide equivalent emissions were about 80 megatonnes, which represented about 16% of total secondary energy-related emissions [OEE 2005]. Improvement in the energy efficiency of dwellings is, therefore, a focus of federal government agencies interested in reducing the energy use and reducing greenhouse gas emissions.

Canadian housing stock is comprised of 13 million dwelling units. The low-rise single family and attached housing form 68% of the stock as shown in Figure 1. Natural gas is used as a primary fuel for space and water heating in 7.2 million dwellings. Table 1 shows the aging of the housing stock. As shown, 62% of the stock was built prior to 1983 which is currently ready for retrofits and renovations [NRCan 2005a].

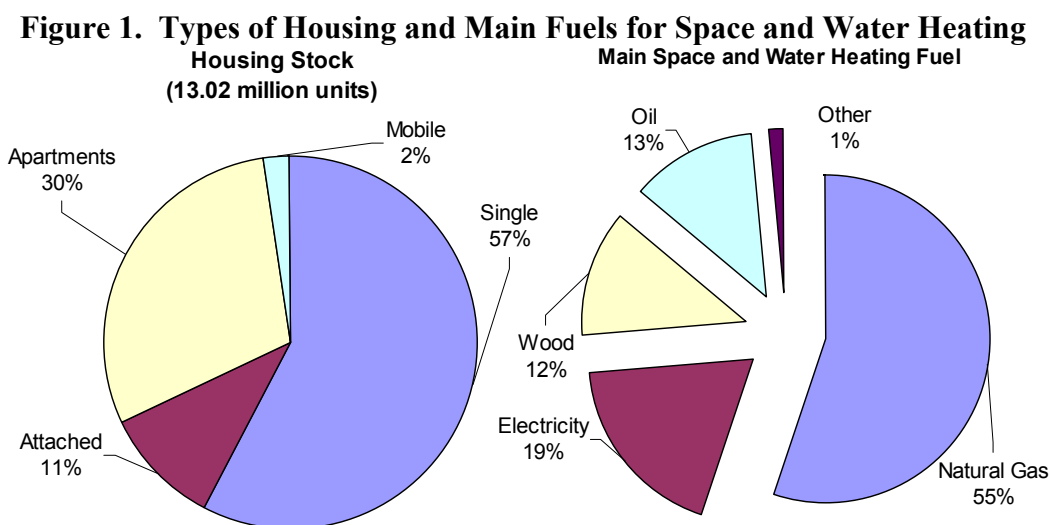


Table 1. Canadian Housing Stock

Vintage	Housing stock (in million)	percentage of total
Before 1946	1.87	14%
1946-60	1.29	10%
1961-78	3.41	26%
1978-83	1.56	12%
1984-95	3.03	23%
1996-2005	1.87	14%
Total	13.02	

It is important to note that residential renovation and repair is a common activity in Canada. Consumer surveys conducted during 2001 and 2004 have determined that about 49% of Canadian households undertook at least one interior retrofit project, and about 31% did at least one exterior project each year. The total amount spent on housing renovation in 2004 was about C\$23.6 billion, an amount comparable to that spent on the new housing construction [CMHC 2005]. This large and well-developed home retrofit and renovation market provides a significant

opportunity for promoting energy-efficiency-related upgrades. Energy efficiency aspects included with common renovation measures would minimize the incremental costs associated with upgrades. For example, every year about 152,500 existing houses replace or upgrade space-heating equipment (furnace or boiler) [HRAI 2004]. By piggy-backing on the base cost of the equipment, the incremental cost associated with high-efficiency equipment relative to commonly available mid-efficiency equipment can then be recouped in a reasonable period of 3 to 5 years.

The EnerGuide for Houses program is an initiative of the Office of Energy Efficiency of Natural Resources Canada (NRCan) that has a mandate to promote energy efficiency in houses to reduce the environmental impact of energy use. This paper describes various elements of the EGH program including the delivery network, data gathering and the incentive process and shows the impact of the incentive component on the overall delivery of the EGH program.

The EnerGuide for Houses Program

Development of EGH Program

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 a comprehensive 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, financial institutions, and consumer and real estate groups) 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 [US-HERS 1996]. In this process, several voluntary committees were formed to guide the development of uniform energy rating procedures. 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, clear and useful to the homeowner.

Prior to the launch of the Program, NRCan spent significant efforts in the overall design, technical guidelines, evaluation procedures, energy evaluation software, homeowner reports, program implementation and tracking procedures, quality control procedures and advisor training courses. After a number of consultations with various stakeholders and focus groups, NRCan selected the name EnerGuide for Houses. The 'EnerGuide' is an official mark of 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 more. The 'EnerGuide' mark has an excellent brand-name reputation with homeowners and

was seen as a guiding tool for energy efficiency. 'EnerGuide' is proving to be well suited for the energy efficiency rating of houses.

In October 2003, the federal government introduced a financial incentive component to further promote energy efficient retrofits.

Scope and Objectives of EGH Program

The main objectives of the EGH program 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 existing homes;
- identify and prioritize energy efficiency upgrades, giving homeowners the facts needed to make informed decisions;
- promote the implementation of energy efficiency retrofit in all renovations;
- serve as a marketing tool to 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 a home's annual energy consumption;
- offer financial incentives to homeowners/clients for successfully achieving energy efficiency; and
- quantify and verify actual home energy improvements, for statistical and program design and evaluation purposes.

Process Components of EnerGuide for Houses Program

These include:

- Delivery and contracting mechanism
- Technical guidelines
- Data gathering, payments and verification

EGH Delivery and Contracting Mechanism

Figure 2 shows the structure of the EGH delivery mechanism. Natural Resources Canada maintains the ownership of the program. It provides the management, marketing, administrative and technical tools to EGH contractors. EGH contractors advertise and sell energy efficiency evaluations to clients/homeowners.

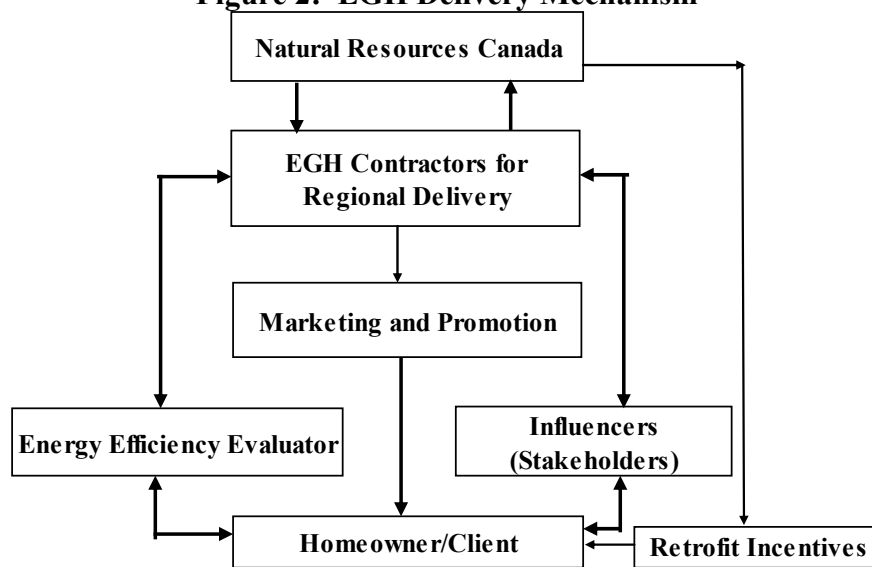
The EnerGuide for Houses is delivered under competitively-bid contracts by a network of EGH contractors across Canada. The requests for proposals (RFP) are periodically posted on the MERX (federal government procurement service). Bidders must meet stringent technical requirements, show that they have the capacity to train and manage energy advisors, provide first-line quality assurance, and offer the service in their area. EGH contractors can deliver EGH using their own staff or can sub-contract to qualified personnel. The EGH contractors sign legal

agreement with Natural Resources Canada to deliver the service in their chosen regions. As part of the legal bindings, EGH contractors agree to meet the stringent Code of Ethics. For example, EGH contractors are prohibited from referring specific retrofit companies to their clients and from having direct links with companies that provide products and home retrofit services.

EGH contractors are paid by NRCan on a ‘per file’ basis. This means that when there is a successful EGH evaluation of a house, the EGH contractor submits this file for payment. There are two types of energy evaluations. The first evaluation, known as ‘A’ file, is done to assess the energy efficiency opportunities for a dwelling. In this case, the energy advisor provides a detailed report and EGH rating label to the homeowner/client. The second evaluation, known as ‘B’ file, occurs after the retrofits and renovations. The EGH incentive is based solely on the energy efficiency improvements measured. The EGH incentive application is prepared by the energy advisor with the client and sent directly to NRCan, where it is matched up with the electronic data file submitted via internet by the EGH contractor. EGH incentives are generally paid within 45 days but no more than 90 days.

There are currently 40 EGH contractors across Canada, ranging from utilities and government agencies to home inspection firms, energy specialists, consulting engineering firms and environmental non-profit organizations.

Figure 2: EGH Delivery Mechanism



Technical Guidelines

The technical guidelines provide the detailed procedures for energy efficiency evaluations of houses, energy analysis methods, criteria for EGH ratings and quality assurance methods [NRCan 2005b].

The EGH advisor 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.

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 used. 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 currently not considered in the rating calculations. The rating system assumes pre-defined base loads for appliances and domestic hot water with the intent of eliminating from the calculations, lifestyle practices.

Occupancy and operating conditions. The EGH rating is determined using standard occupancy and operational conditions [NRCan 1997].

- four occupants (two adults and two children) present in the home 50 percent of the time;
- a thermostat setting of 21 °C for main floors and 19 °C for basement and storage rooms;
- consumption of 225 litres of domestic hot water at 55 °C per day;
- electricity consumption for lighting and appliances 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
- a 30-year average weather data.

EGH rating calculations. The EnerGuide rating is defined as:

$$\text{Energy Efficiency Rating} = 100 - ((\text{Estimated Total Energy Consumption} / \text{Reference Energy Consumption}) * 20)$$

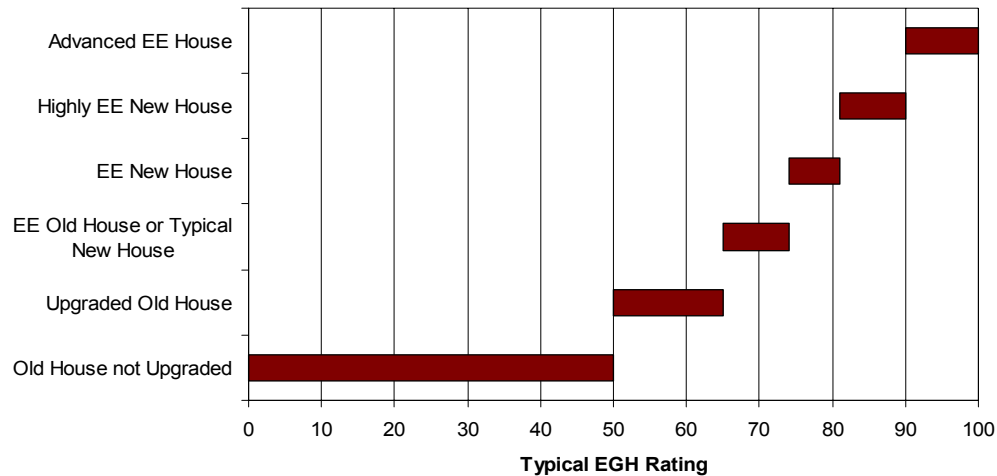
The estimated total energy consumption is determined using the EGH approved energy analysis software (such as HOT2 XP and HOT2000 [NRCan 1996] using the above-mentioned operating conditions. The reference energy consumption is based on the house size and location. While DHW load is fixed, system efficiency can impact the rating.

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. 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. Figure 3 shows a typical range of EGH ratings for different types of houses. Typically, the higher the rating, the lower the annual energy bills.

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 advisors and, (b) promote adherence to various procedures and objectives of the Program. To satisfy these goals, two approaches are

implemented: (1) EGH contractors periodically conduct random file reviews of houses that have been rated; and (2) NRCan conducts a detailed review of house data collected at all stages.

Figure 3. Typical EGH Ratings for Canadian Houses



The EnerGuide for Houses Database

After completion of each energy evaluation, the EGH contractor submits the house data files via internet to the EGH database. This central database maintains records of each house with regards to its physical characteristics and energy use. The EGH database also keeps track of payments to EGH contractors as well as homeowner incentives. This database is strictly limited to NRCan staff for privacy issues. The housing characteristics can be made available to others for further analysis.

EGH Delivery Costs

NRCan has developed a unique delivery model for the EnerGuide for Houses program. EGH contractors invest in the infrastructure for the delivery of house evaluations. NRCan only pays for the house data files submitted by the EGH contractor. For each acceptable house data file, NRCan pays on average C\$150. The EGH contractor generally charges C\$150 to homeowners. The cost sharing is intended to develop a self-sustained energy efficiency retrofit market.

EnerGuide for Houses Retrofit Incentives

In October 2003, as part of the Government of Canada's commitment to reduce greenhouse gases, retrofit incentives were officially offered. With the financial incentives, homeowners can qualify for a non-taxable grant when they retrofit their homes.

Eligibility Criteria for EGH Retrofit Incentives

The following criteria were developed for qualifying incentives to homeowners:

Eligible recipients. Residential property owners are eligible for a grant under the EnerGuide for Houses Retrofit Incentive provided that:

- they have received a pre-retrofit energy efficiency rating under EGH
- they have performed, or have had performed on their behalf, energy efficiency retrofits
- they have received a post-retrofit energy efficiency rating under EGH that shows the dwelling has met or exceeded the energy efficiency improvement levels required to meet the threshold for a grant
- they permit the EGH contractor organization to submit the dwelling's electronic data file to NRCan

Eligible homes. To be eligible for the grant, the dwelling must be in Canada and:

- must be either a low-rise residential dwelling, that is a detached, semi-detached or row house that is no more than three and a half storeys high, and that has a footprint of not more than 600 square meters (6,458 square feet) or a mobile dwelling on a permanent foundation (as defined in Parts 9 and 2 of the National Building Code of Canada, 1995);
- must be capable of receiving a rating under EGH (if an energy advisor observes factors that in his or her opinion suggest the structure of the building may be unsafe or that may affect the health of occupants, the energy advisor shall have the authority to refuse to rate the house); and
- must be habitable year round.

Conditions of payment:

- The grant payment shall be based solely on the difference between the pre-retrofit and the post-retrofit rating, be provided only one time per owner, per dwelling, be provided to eligible owners with the understanding that dwelling owners shall accommodate NRCan in quality assurance when requested to do so.
- Owners shall accept full responsibility for the work performed, including choice of materials and service provider for renovation work, obtaining all applicable permits and paying all applicable taxes on work performed.
- Owners are required to retain receipts for renovation work completed for three (3) years following the date of submission of a grant application. Such receipts may be required for the purpose of evaluating the grant program, for example, by identifying how much of the total renovation costs were supported by grant funding. It should be noted that the incentives are solely based on the improvement in the energy efficiency, change in the EGH energy rating, and not on the cost of the retrofits.

Incentive calculations:

- The EGH incentive is based on the change in rating between the first and second evaluation rating which is a reflection of the energy efficiency improvements achieved with retrofits.
- The cost of the retrofit is independent of the rating change.

- There is a minimum energy efficiency improvement required for the “B” evaluation. The incentive is based on a scale from “20 or less” to 100. It is considerably easier to perform high-return retrofits, and therefore achieve rating points, at the low end of the scale than at the high end of the scale. To ensure balance in the awarding of incentives, larger “hurdles” are set for the low and medium-efficiency houses.
 - Houses that rate at 32 or less must meet EGH rating of 40 to be eligible to receive a rebate.
 - Houses that rate at 61 or above must achieve a minimum hurdle of 2 points to be eligible to receive a rebate.
 - Between 40 and 61, the hurdle is recalibrated gradually from 8 to 2 points.
- The incentive can range from C\$215 to C\$4,580.

Energy Savings

The EGH database provided the energy analysis results of 57,700 retrofitted houses. The EGH rating for existing houses ranged from zero to 91 points with an average of 56 points. Recommended energy efficiency measures would improve the EGH rating by about 17 points. This is about a 40% reduction in annual energy consumption. The second EGH evaluation after the retrofits showed that the EGH rating improved to an average of 68 points. Data analysis showed that homeowners installed about two-thirds of recommended measures. The average energy savings of retrofitted houses was 28%.

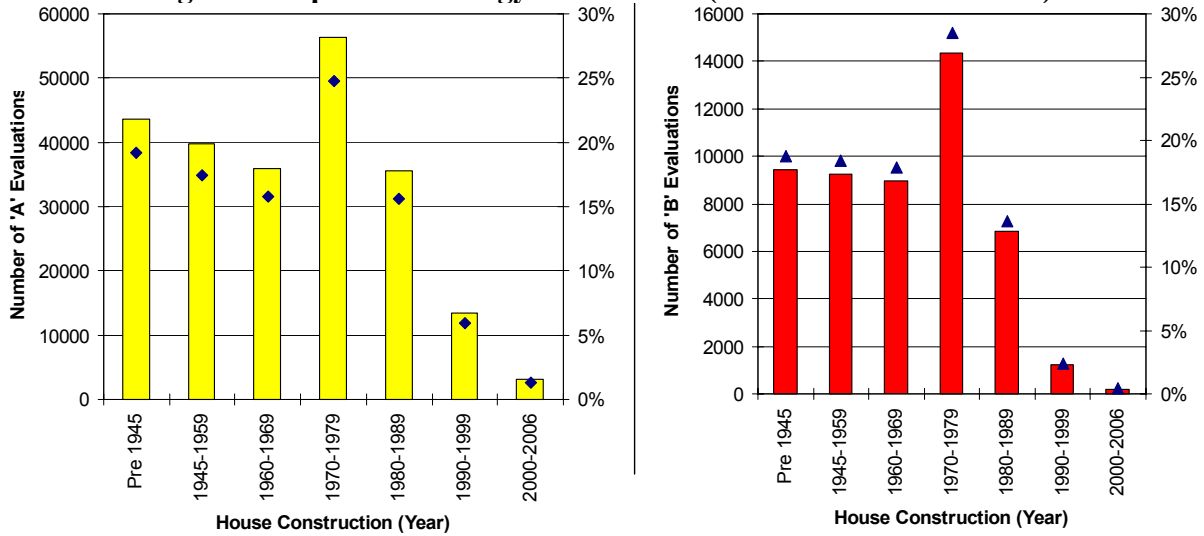
Based on the analysis of retrofitted houses, the energy efficiency upgrades would reduce the GHG emissions up to 6.4 tons/year/house for houses pre-1945 with an average of 3.9 tons/yr for all retrofitted houses.

Further, data analysis showed, in Figure 4, that 82% of pre-retrofit EGH evaluations were for houses that were 15 or more years old. The post retrofits showed that homeowners are inclined to implement retrofits in houses that are 20 or more years of age.

Impact of the Interventions of Retrofit Incentives

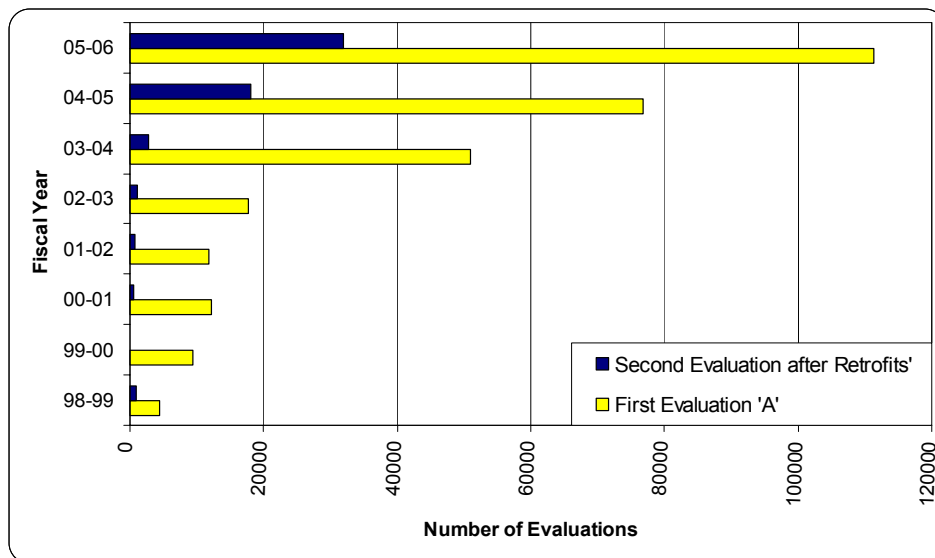
Since the introductions of incentives for retrofits, the uptake of EGH services increased substantially. As shown in Figure 5, since the introduction of incentives for retrofits, more and more houses have been evaluated each year. The growth in the service shows the market reaction to the incentive. Since the EGH program began, over 252,000 houses have been evaluated - 78% after the incentive intervention. The incentives are tied to the energy efficiency retrofits. The second evaluations, after the implementation of retrofits, now count for 60,800 houses - about 24% of the total houses evaluated. Again, the retrofit incentives accelerated the uptake of ‘B’ evaluations.

Figure 4. Uptake of Energy Evaluations (Pre- and Post- Retrofits)



By end of fiscal year 2005-06, over 49,000 households have received EGH retrofit grants totaling C\$36.5 million. The EGH retrofit incentive amount averaged about C\$735 per applicant. The annual energy savings range from 12% to 45% with an average of 28%. This is a significant achievement.

Figure 5. Uptake of Energy Evaluations



NRCan conducted annual surveys of EGH homeowners to assess the impact of the Program on implementation retrofits, typical measures and also challenges and barriers [Statplus, 2005]. For example, 78% of homeowners reported achieving significant energy savings after implementing measures. Overall, the majority of homeowners (93%) reported satisfaction with the EGH process including the energy advisor’s visit, EGH report and post-retrofit incentives. The survey also identified a need for ‘how to’ retrofit guidance for homeowners. Typically, homeowners spend C\$3,500 to C\$6,000; work is done by the homeowner, contractors, or a combination of both.

Utility and Stakeholder Participation

There are 'top up' grants now being offered to EGH participants by some utilities and provincial governments. Examples include:

- Nova Scotia provides a top-up grant up to a maximum of C\$1,000 per participant. Low-income seniors receive an additional C\$400 grant plus a C\$150 refund for the cost of the evaluation.
- New Brunswick is offering EGH participants an interest-free loan up to C\$10,000 to help pay for energy-efficiency improvements or a cash rebate of up to C\$1,500 for the 15% sales tax on the cost of materials and labour.
- Hydro Québec provides an incentive equivalent to double the federal EGH incentive to customers who heat their homes with electricity.
- Saskatchewan offers a matching grant up to a maximum of C\$2,000. For middle-income households, the matching grant limit is up to C\$4,700.

Piggybacking with Energy Efficient Heating Equipment

The Heating Refrigerating and Air-conditioning Institute (HRAI) of Canada are promoting the furnace and boiler replacement rebate along with EGH grants. Equipment manufacturers provide a rebate ranging from C\$100 to C\$350 per system for ENERGY STAR[®] compliant equipment.

Summary and Conclusions

The EGH program has a solid foundation to deliver energy efficiency ratings and reliable retrofit advice to homeowners. Since it was launched, 252,000 houses have been rated across Canada of which about 60,800 houses have been re-evaluated after retrofits. The program has flourished successfully with the advent of financial incentives which facilitate the energy efficiency retrofits in Canada. 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 methodology, evaluation procedures and house assessment tools seem to work well in the marketplace. Independent energy advisors / contractors deliver the EGH program.
- 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 were inclined to implement retrofits in houses that are 20 or more years of age.
- On average, energy evaluations recommended reductions in energy consumption by about 25%. Average uptake rate is about two-thirds 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.
- The energy efficiency upgrades would reduce the GHG emissions up to 6.4 tons/year/house for houses pre 1945 with an average of 3.9 tons/yr for all houses retrofitted under EGH.

- The EGH retrofit incentives have increased the level of participation by homeowners. Utility and other stakeholder participation has generated excitement in the retrofit market.

The EGH retrofit incentive program is proving to increase energy efficient retrofit implementation in housing.

References

CMHC 2005. National Renovation Markets. Canada Mortgage and Housing Corporation, Canada.

HRAI 2004. Gas Furnace Shipment Data. 1999 - 2004.

NRCan 1993. Home Energy Retrofit in Canada – Overview and Opportunities including Recommendations emerging from the Retrofit Options Workshop held on November 4-5, 1993. Natural Resources Canada, Canada.

NRCan 1996. HOT2 XP version 2.74. Express Residential Energy Analysis Software. Natural Resources Canada. (<http://buildingsgroup.net> or <http://groupedubatiment.net>.)

NRCan 1997. An Investigation of Rating Sensitivity to Ventilation Rate Adjustments and Choice of Standard Occupancy and Operating Conditions. Natural Resources Canada.

NRCan 2005a. Energy Efficiency Trends in Canada – An Update on the Indicators of Energy Use, Energy Efficiency and Emissions. Jun 2005. Natural Resources Canada, Canada.

NRCan 2005b. Energy Advisor Workshop Manual, December 2005. Natural Resources Canada.

OEE 2005. Improving Energy Performance in Canada – Report to Parliament under the *Energy Efficiency Act* – 2004-2005

Statplus, 2005. EnerGuide for Houses – Statplus Report from April 1, 2004 to March 31, 2005. Natural Resources Canada. Canada.

US-HERS. 2006. 2006 Mortgage Industry National Home Energy Rating Systems Standards. Published by Residential Energy Services Network (RESNET), Oceanside, CA. http://www.natresnet.org/standards/resnet_standards-2006.pdf