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UTILIZATION OF RESIDENTIAL ENERGY-SAVING RETROFIT PROGRAMS IN CANADA: WHO, WHAT AND WHY

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Residential home retrofitting appears to have great potential for energy saving and hence for GHG emission reduction. In Canada, it has been estimated that about 46% of the emission reductions requirements of the residential sector under the Kyoto Accord can be achieved through retrofitting shell and furnace improvements. This reflects the fact that some 70% of the current Canadian housing stock was constructed prior to 1980, when many of the energy conservation programs started, and that houses of this vintage are about 25-40% less energy efficient than those that meet the R2000 standard. Despite this potential, a survey of residential retrofits conducted in 1994 showed that only about one in twenty homeowner households undertook major work (improved insulation and improvements to windows and doors) aimed at improved energy efficiency.

Since the vast majority of residential energy consumption is for space heating, improvements in existing structures through various energy efficiency retrofit upgrades appear to be the single most important activity required to achieve the goals of reducing energy use and hence GHG emissions in the residential sector. Building energy retrofits are of great significance not only because there are widespread energy savings opportunities in the buildings sector, but also due to their relatively low cost requirement, their ancillary benefits in the form of improved thermal comfort, and the fact that conservation through retrofitting does not involve major adjustments to consumers' lifestyles, and it offers potential economic returns to the consumer. Various policies and policy incentives aimed at improving residential energy efficiency and thereby reducing GHG emissions in Canada attest to the perceived importance of residential retrofit programs.

As part of their commitment to the Kyoto Accord, in 1998 the Canadian federal government began a program asking all citizens to be part of a Canadian effort to reduce GHG emissions by one tonne per year, on average, assisted by incentives, improved information, and product availability. For the residential sector, the Canadian climate change action plan indicated that the government would attempt to achieve the targets by creating conditions for more informed choices through cost-shared home audit programs for homeowners and by providing information to encourage consumers to purchase cost-efficient appliances and equipment.

The EnerGuide for Houses (EGH) program is one of the methods that have been used in Canada to achieve these goals. This program provides an evaluation service to homeowners along with information on energy-efficiency improvements for their homes. In simple terms, it is a home energy audit program with an incentive package. An EGH evaluation costs between $300 and $350, although the effective cost varies across regions because some provinces subsidize this service. Upon request by a homeowner, energy use experts make an assessment of how the house uses energy and where energy is being lost. The information collected during the audit includes construction characteristics and thermal properties of the houses, as well as details of space and domestic hot water heating equipment. The collected data are used for modeling home energy use, which

generates estimates of home energy consumption and costs as well as EGH energy-efficiency ratings, and is used to determine energy-efficiency upgrade options. Based on the information that is compiled, a list of improvement recommendations is provided to the homeowner and recorded.

Even though it is believed that the retrofit costs are recoverable through energy savings, as an incentive for undertaking the recommended retrofit actions, beginning in Fall 2003 (although discontinued in 2006 following a change in government) the Government of Canada provided grants to homeowners who completed energy efficiency retrofits based on EGH advisor recommendations. The grant amount depended on the difference between the pre- and post-retrofit EGH ratings of the houses. Only homes that are evaluated using the EGH service were eligible for the government grants. Thus, homeowners had to request the EGH auditors to conduct a second round assessment and the auditors had to be satisfied that the minimum energy efficiency improvements had been achieved in order for the homeowner to qualify for a government grant. There was also a time limit in terms of the period between the first audit and time when the homeowners implement the recommendations and have their second audit review in order to qualify for the grant.

The EGH audit reports have resulted in a very rich data set which contains the information compiled during both the first and the second audits. By the end of 2005, over 180,000 homeowners across Canada had ordered first time EGH audits, and approximately 18% of these had undertaken sufficient retrofits to justify them following up with a second energy audit. This second audit process provides similar information to the first audit, as well as a description of the specific upgrades that were undertaken along with estimates of post-retrofit energy consumption and energy efficiency. These estimates can be compared to the pre-retrofit case as well as to what would have been expected based on adoption of each of the recommended upgrades.

The data that have been assembled concerning the EGH program raise a number of questions that are addressed in this paper. Primary among these is the determination of who undertakes retrofits, and what induces them to do so. With only 18% of households who undertake the first audit following up with a second audit, it would appear that the mere existence of the program in itself will not be sufficient to induce the desired aggregate energy savings for Canadian households. This problem is exacerbated by the fact that only a relatively small proportion of Canadian households even undertook the first audit. Thus, our analysis focuses on the questions of (i) who (what types of household) undertakes the first and/or second audit, (ii) what appear to be the main factors that induce only some of the households that completed the first audit to then undertake retrofits and follow through with the second audit (and which households are most likely to do so), (iii) what are the main types of retrofits chosen by those who do undertake retrofits, and (iv) why is this the case – what are the determinants of the amount of retrofitting that is done (the retrofit intensity) and of the probability of undertaking at least one upgrade (the retrofit propensity). Clearly, the answers to these questions have important implications for improving the effectiveness of the EGH program as well as, more generally, other types of programs aimed at improving residential energy efficiency through retrofitting.

A preliminary conclusion that has emerged from our statistical and econometric analysis of the EGH dataset is that both the decision to undertake energy retrofit investments and the retrofit intensity depend on the extent of inefficiencies observed in energy use, and

therefore the expected high savings from investing in upgrades. However, the EGH database contains information about the houses but not the homeowners, so that to control for the effects of demographic and socio-economic factors on these decisions, our ongoing analysis to be reported in this paper supplements the EGH data by linking EGH building location with demographic and socio-economic information obtained for each such location from census and tax filer data.