Research & Development Highlights

95-210 Technical Series

Energy Efficiency Technology Impacts Appliances

Introduction

In accordance with the 1988 Toronto Protocol, Canada is committed to a 20% reduction in "greenhouse" gas emissions by the year 2005. Improving the energy efficiency of housing can contribute to meeting these targets. Many research initiatives are being conducted to evaluate the energy consumption patterns of dwellings to identify ways to reduce energy use. This project assessed the impacts of improving the energy efficiency of household appliances upon residential energy end-use, national energy consumption and carbon dioxide emissions.

Household appliance energy consumption can be significant. Improving appliance efficiency will reduce appliance energy consumption. However, the overall impact on total residential energy use is not readily obvious. This is due to the complexity of the interrelationships between appliance energy use and space conditioning/domestic hot water heating loads and other related factors. Consequently, computerized simulations of annual residential energy consumption patterns are required to assess these relationships and to determine the overall impact on energy consumption.

This project evaluated the impact of increasing the efficiency of selected appliances on residential energy end use, national energy consumption and carbon dioxide generation. An expanded version of the CMHC Statistically Representative (STAR) Housing database and an hourly building energy consumption simulation program were used for the analysis. Simulations were also performed to evaluate the cumulative effects of improving the efficiency of appliances and other systems such as the building envelope, furnaces, and hot water heaters. The results of each simulation were extended to the national housing stock in order to determine the impacts on national energy use and carbon dioxide emissions.

Project Obectives

The objectives of this project were:

- to develop a graduated classification of residential appliances based on market penetration and the impact on residential energy consumption,
- to identify load profiles and the energy consumption patterns of appliances,
- to evaluate the impact of increasing the energy efficiency of appliances on residential energy end use, national energy use and carbon dioxide generation, and
- to evaluate the impact of increasing the efficiency of appliance efficiency in conjunction with other building system energy efficiency improvements and changes to occupant habits or lifestyles.

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Research Program

A literature search was performed to identify common residential appliances, load profiles, energy consumption characteristics and market penetration levels. Increments in the energy efficiency of appliances were predicted based on new and emerging technologies.

The STAR housing data base was reviewed. Files with errors or omissions were corrected or deleted as necessary. Additional house data files were obtained from other sources to form a data base of nine hundred and thirty-seven house files. Each house in the data base was assigned a specific set of appliances based on the information generated by the literature search. The compiled database was compared to recent Statistics Canada housing information to determine the degree to which it was representative of the Canadian housing stock.

The impacts of improving the energy efficiency of the appliances contained in the data base houses were evaluated using the ENERPASS and HOT2000 building energy simulation programs. Improving appliance efficiency in conjunction with improvements to the building envelope, fuel utilization efficiency, occupant habits and lifestyles was also evaluated. The conversion of space heating and domestic hot water fuels was modelled to evaluate the impact of fuel conversion programs on energy consumption and carbon dioxide generation. The EINERPASS and HOT 2000 simulation program results were compared to determine their relative merits.

The results of each simulation was projected to the national housing stock to evaluate the overall impact on national residential energy consumption and carbon dioxide generation. In all, thirty different energy efficiency improvement scenarios were modelled.

It should be noted that the analysis did not include an assessment of the effects of the energy efficiency improvements on air-conditioning loads or peak electrical demand loads.

Findings

The original and expanded versions of the STAR housing database are not sufficiently representative of the regional housing distribution and the primary fuel types used in houses in Canada. This limits the ability of the analysis performed to accurately estimate actual national energy savings and subsequent reductions in carbon dioxide generation due to the energy efficiency upgrades modelled. The following are conclusions of the simulation studies, subject to these limitations:

- **The** heat gain from appliances is not always useful heat gain, therefore, it is not beneficial to “heat” houses with appliances regardless of heating fuel type.

- As the energy efficiency of appliances increases, the energy consumed for domestic hot water decreases and the energy consumed for space heating increases. Generally, the net result is a reduction in total residential energy end use.

- The impact of improving the efficiency of appliances on national residential energy consumption and carbon dioxide generation is relatively small.

- The simultaneous improvement of the energy efficiency of appliances, building envelope, heating and hot water systems, occupant habits and lifestyles can have a significant impact on residential energy consumption, national energy use and carbon dioxide generation.

- Depending on location, energy use and carbon dioxide emissions can be reduced by converting houses from oil and propane to natural gas and electricity heating.

A statistically representative housing database can be a valuable resource to assess the impact of energy efficiency upgrades on residential energy consumption in an effective and efficient manner.

Implications for the Housing Industry

The results of this study suggest that programs directed at increasing appliance efficiency alone will not have a significant impact on overall residential energy consumption and carbon dioxide generation. Effective energy efficiency measures must include improvements to the building envelope, mechanical systems, fuel type used and the habits of the occupants.

The results also suggest that potential residential energy conservation programs must be thoroughly evaluated prior to implementation to determine the impacts at the national level as these impacts may not be obvious at the regional or household levels.

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A full report on this research project is available from the Canadian Housing Information Centre at the address below.

Housing Research at CMHC

Under Part IX of the National Housing Act the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This factsheet is one of a series intended to inform you of the nature and scope of CMHC's technical research program.

*The **Research and Development Highlights** factsheet is one of a wide variety of housing-related publications produced by CMHC.*

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