

Identifying Residential Energy Reduction Potential

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Introduction

Ontario Hydro is involved in a series of studies to identify and quantify the energy and load reduction potential of electrically heated homes. From these interlinked studies it is hoped not only to quantify attainable potential energy and load reductions but to provide input into the design of future energy conservation programs.

Approach Taken

1000 House Audit

Concentrating only on electrically heated residential housing a statistically selected group of 1000 houses, representative of the Ontario housing stock, was audited. The sample covered 26 communities across the province and encompassed all structure types of detached, single family houses.

These 1000 houses received an energy audit with the results entered into a computer database. The energy consumption of these houses was analyzed using the PRISM

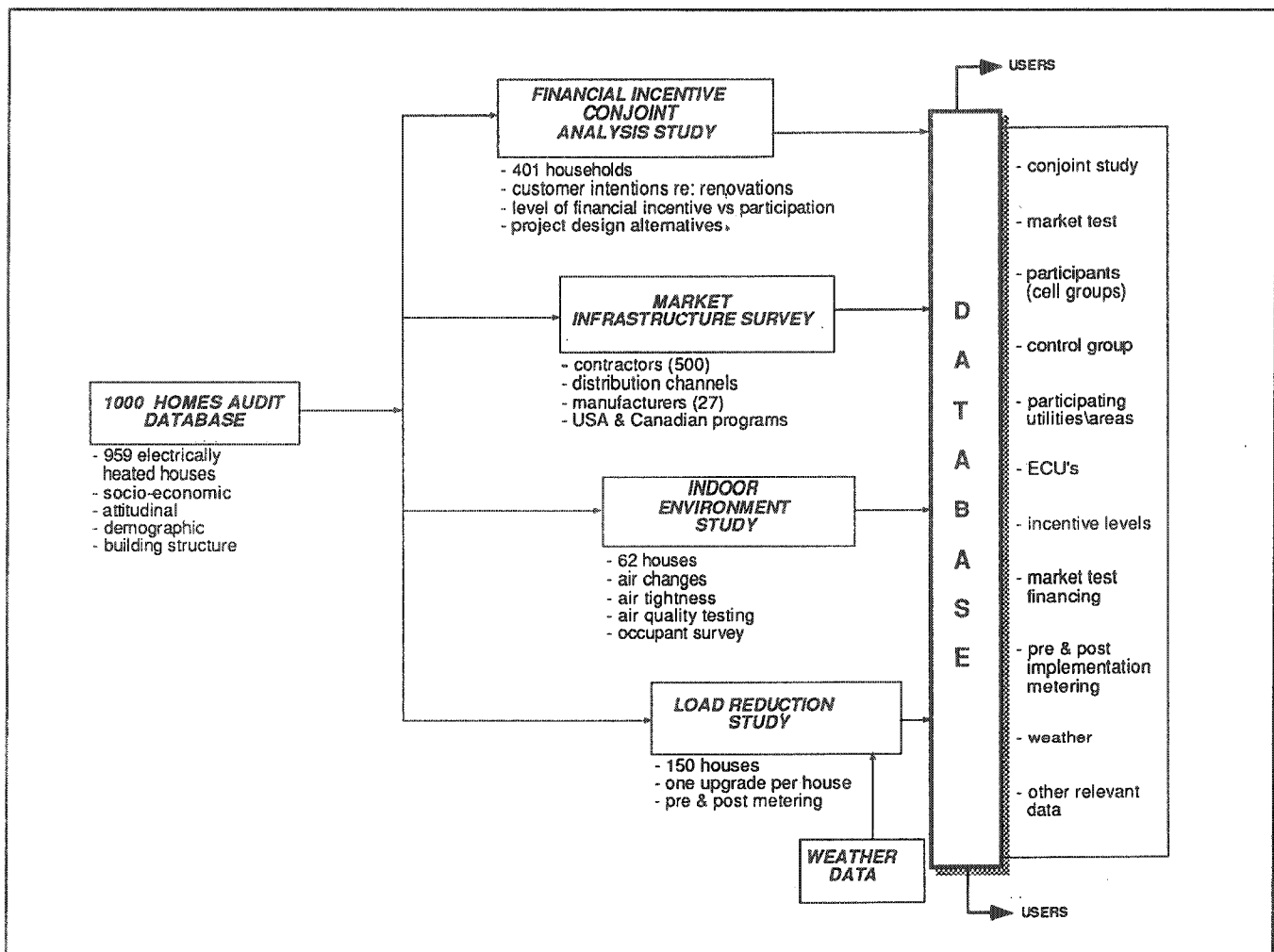


Figure 1. Residential Existing Housing Projects

computer program and cross referenced to HOT 2000, an energy analysis program, which identified energy savings attributable to 46 different energy conservation upgrades (ECU).

Results from the analysis were extrapolated to the total electrically heated housing stock and identified 1330 MW of *economically* attainable load reduction potential. This further broke down to 600 MW from improvements to the thermal envelope and 730 MW from upgrades to heat pumps.

Other findings were:

- 92% of houses received at least one economic ECU recommendation
- 86% of houses received at least one thermal envelope improvement recommendation
- there were an average of 3.6 ECUs recommended per house when including heat pumps and 3.3 thermal envelope ECUs per house when excluding heat pumps.

Financial Incentive Conjoint Analysis Study

Having identified the potential of Energy Conservation Upgrades a study was undertaken to: determine the amount of incentive that should be used in a financial incentive market test, determine the sensitivity of customer intentions to implement ECUs based on various incentive levels, identify effective program design alternatives, and determine relevant energy demographics of customers most likely to participate in energy management programs.

Among the results from this report are:

- heat pumps generally remain a very hard sell
- offer the maximum rebate possible
- warranties are expected and necessary
- there is a credibility issue as to why a utility would offer rebates
- offer flexibility in terms of contractor choice and do-it-yourself option.

Table 1. ECU Characteristics by Component Group

	% of Houses Having at Least One Economic ECU (%)	16-Hour Average Peak Savings (kW)	Average Annual Energy Savings (kWh/yr)
Thermal Envelope Upgrades:			
Air Sealing	29	0.19	648
Ceiling/Attic Insulation	40	0.75	2408
Wall Insulation	21	1.01	3256
Basement Insulation	44	0.51	1608
Window Upgrade	23	1.34	3868
Door Upgrade	30	0.17	567
Heat Pumps (after envelope upgrades):			
Air Source	<1	0.67	2864
Burner-Assisted	38	3.11	6014
Ground Source	13	5.31	11423

Market Infrastructure Survey

The objectives of the Market Infrastructure Survey were: to identify/evaluate the major barriers/success factors in existing housing retrofit programs, to determine a quantitative and qualitative measure of existing supply of residential contractors, and to determine the project management activities and degree of contractor screening and evaluation necessary to administer energy management programs.

Highlights of the study include:

- "every problem that can arise in energy conservation programs has already arisen", look at the experiences of others before beginning.
- to ensure the quality of work, monitoring is required.
- a base of quality contractors exists but it needs expanding and upgrading in "energy conservation" aspects.
- a high inspection rate is recommended - up to 100%

Indoor Environment Study

The purpose of the Indoor Environment Study was to assess existing air quality and examine the air quality concerns that may develop as a consequence of undertaking energy conservation programs.

Among the findings of this study were:

- significant potential for upgrading houses exists with minimal adverse effects on air quality.
- air change rates are higher than anticipated from calculations based on weather data and house airtightness.

Load Reduction Study

The Load Reduction Study involves the upgrading and monitoring of 150 houses which were part of the 1000 House Audit. The purpose of this project is to obtain quantification of the actual energy and load impacts associated with a range of thermal envelope upgrades (ECU's) identified as economic. Results will allow Ontario Hydro to improve the estimate of the total province wide potential of load reduction in the existing stock of electrically heated houses and to improve future program design and evaluation.

To quantify energy savings, all of the houses in the original 1000 House Study had monthly meter readings collected starting with the heating season before envelope upgrades were installed and continuing for two years after the upgrades. Pre and post-retrofit energy savings are obtained using PRISM with the monthly meter readings.

Remote Interrogation Meters (RIMs), which remotely read electrical load every 15 minutes, are being used to quantify actual changes in electrical load. The subset of 150 upgraded houses from the 1000 House Study are equipped with RIMs and they will continue to be monitored for two years after the installation of the upgrades.

The retrofitted houses received only one upgrade from one of the following 5 categories: air sealing, attic insulation, wall insulation, basement insulation, and window upgrade. The energy and load changes will primarily be attributable to the one particular upgrade performed on the house.

Post retrofit metering and analysis is currently under way. It is too early to draw final conclusions about the effect of the energy conservation upgrades undertaken on electricity consumption and load levels.

Discussion

Through a series of residential energy studies Ontario Hydro has been able to identify and quantify the energy savings and load reduction potential of electrically heated houses in Ontario.

Acknowledgments

This paper presents the results of a progression of studies undertaken by number of people at Ontario Hydro and acknowledgement is due to all of them.

References

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