

Home heating and the environment

by Bradley Snider



The improvement of society's standard of living is generally seen as a desirable goal, but it sometimes seems to conflict with the equally valid goals of maintaining the quality of the environment and operating within the limits of finite non-renewable resources; in other words, sustainability.

The ratification of the Kyoto treaty and rising energy costs have renewed interest in the environmental impact of household heating. This is a highly visible use of energy with which most Canadians are intimately familiar. But as with all activities involving energy use, the heating and cooling of our homes have consequences for our environment.

In 2003, the residential sector accounted for about 6% of total Canadian greenhouse gas emissions.¹ That percentage may appear low, especially when compared with the transport sector which was responsible for about 26% of greenhouse gas emissions. However, the impact of the residential sector could have been much greater if the type of energy used to heat Canadian homes had not changed so dramatically over the past 50 years.

Using the Survey of Household Facilities and Equipment and the Survey of Household Spending,

GST What you should know about this study

This article draws on the Survey of Household Facilities and Equipment (HFE) and the Survey of Household Spending (SHS). Beginning in 1947, the HFE collected up-to-date data on household equipment in private households in the 10 provinces, providing information about Canadians' standard of living and identifying changes in household characteristics. As of 1997, the HFE was integrated into the annual Survey of Household Spending (SHS), which obtains detailed information about household spending, dwelling characteristics and household equipment, as of December 31 each year. The SHS covers about 98% of the population in the 10 provinces, with yearly data available for the territories from 1997 to 1999 and every second year thereafter beginning in 2001.

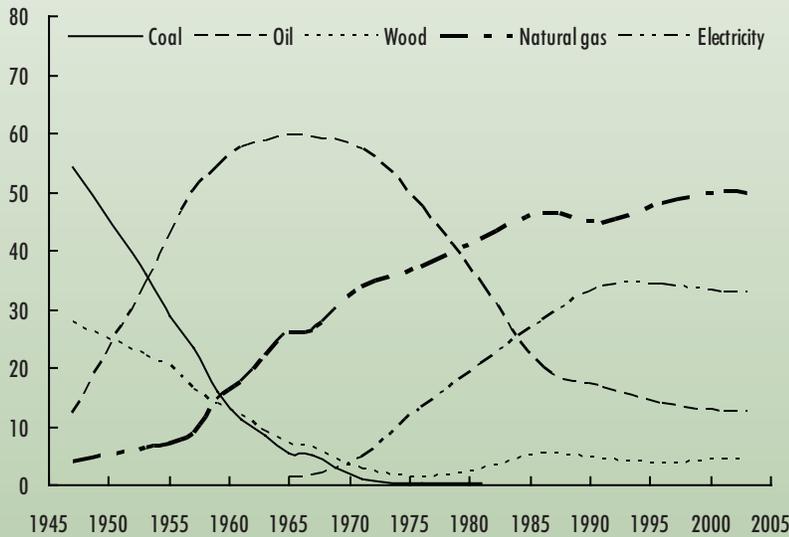
this article shows that, since the 1940s, Canadians have rapidly adopted new energy sources for household heating. It then shows how these important changes have affected greenhouse gas emissions attributable to the residential sector in recent decades.

More households do not necessarily mean more emissions

Individual homeowners can attest that improvements in home design, insulating materials and the efficiency of home heating equipment have

certainly made modern homes more energy efficient. At the national level, two important factors are associated with the quantity of greenhouse gas (GHG) emissions produced by the residential sector: the total number of households and the type of energy used to heat them. Not surprisingly, the greater the number of households, the greater the potential quantity of greenhouse gas emitted into the atmosphere. However, the relationship between the number of households heated and the quantity of emissions is highly dependent on the type of energy used.

% of households reporting



Source: Statistics Canada, Survey of Household Facilities and Equipment and Survey of Household Spending, 1947 to 2003.

All sources of energy are not equally GHG friendly. For example, natural gas and electricity (when produced with low emission technologies such as hydroelectricity) have fewer negative consequences than oil. Thus, if an increase in the number of households is accompanied by simultaneous changes in favour of low emission sources of energy, the negative environmental effects of heating more households might be partially or entirely offset. Over the last half century, energy sources have changed continually.

In 1951 there were about 3.4 million households in Canada; by 2001 the number had reached nearly 12 million. So as a first approximation, the demand for household heating more than tripled over this period.²

However, the type of energy demanded by households has changed dramatically in the last 50 years. In 1947, over 83% of households relied on burning solid fuel – coal (55%) or wood (28%) – with the daily

maintenance and attention that that required. Only 12% of households heated with oil and 4% with natural gas. Electric heating was virtually unknown.

By 1965, less than 20 years later, domestic heating had been revolutionized. Coal and wood had dwindled to only 10% of households, while oil heating had peaked at nearly 60%. The construction of the Trans-Canada natural gas pipeline in the 1950s allowed 26% of homes to heat with gas. Electric heat was still rare, though, reported by only 1% of households.

The oil shocks of the 1970s, and subsequent government policies favouring electricity (in Québec) and natural gas (in Ontario and the Western provinces), precipitated the decline of oil as a heating fuel. Trends in this direction had already begun as early as 1966, suggesting that consumers were responding to their own sense of efficiency and economics. By 1985, oil had

dropped to third place behind gas and electricity as a heating source. Wood heat, interestingly, enjoyed a small renaissance in the 1970s and has accounted for a steady 5% of households since then. Coal, however, has effectively vanished as a home fuel.

By 2003, the picture had changed again. Electricity, which peaked in popularity in the mid-1990s, dropped slightly to heat 33% of households. Oil decreased to only 13% of households, about the same as in 1947, while natural gas reached an all-time high as the heating source for 50% of households.

When the principal energy source is shown in terms of the absolute number of households (rather than the share of households), the picture changes slightly. Here, the decline of oil in absolute terms begins in 1970, but it is still precipitous. Wood is used by almost half a million households, almost as many as in the 1950s. The total number of households using gas in 2003 (over six million) is almost double the number that ever used oil. And although the growth in electric heating seems to have ended in the mid 1990s, electricity still heats more homes in 2003 than oil ever did.

Changes in energy sources used affect greenhouse gas emissions

The quantity of greenhouse gas emissions attributed to the residential sector in 2003 reflects the increase in the number of households, improvements in energy efficiency and heating technologies, and the changes in the types of energy used. Over the past 50 years, the number of households has more than tripled; however at the same time, sources of energy which produce large quantities of greenhouse gas (GHG) – coal and oil – have gradually been replaced by more environmentally friendly sources such as natural gas and hydroelectricity. The evolution of the quantity of emissions attributable to the residential sector in the nineties illustrates very well this situation.

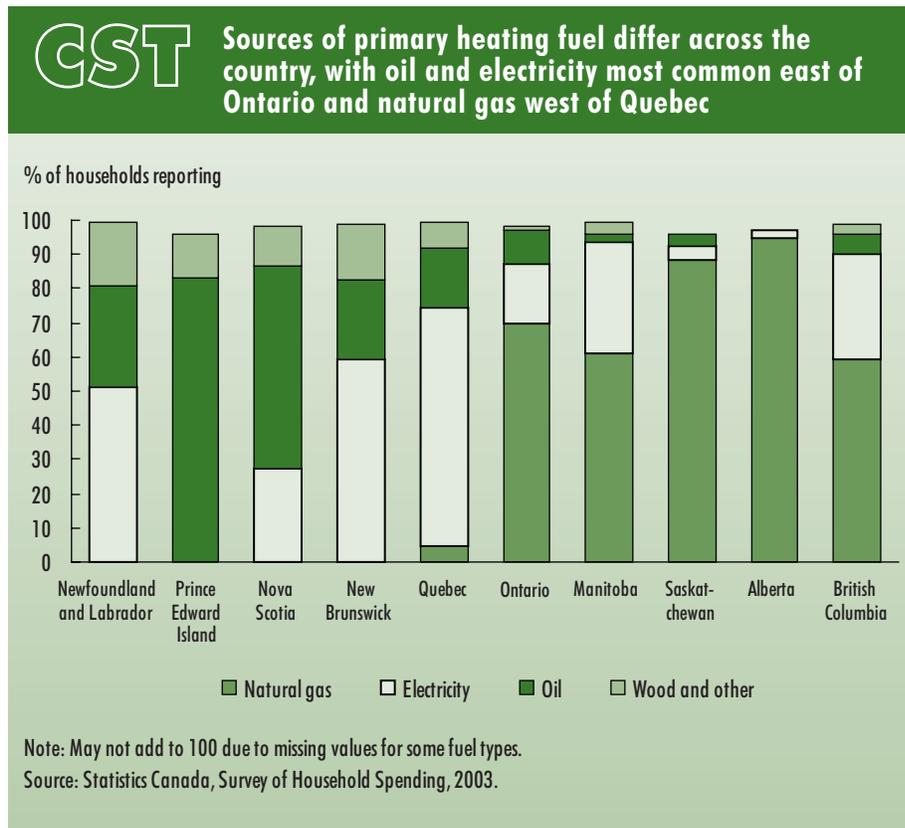
According to a 2005 Environment Canada report, "residential emissions have remained fairly constant between 1990 and 2002, increasing 0.3 Megatons (Mt) over this period".³ This stability could certainly be considered an improvement, given that the number of households grew nearly 22% over this period (from 9.8 to nearly 12 million).

Without changes in the sources of energy used to heat the houses in the past 50 years, the picture would have been much different. If households in 2002 were still using, in the same proportions, the type of energy sources used in 1965, the quantity of GHG emissions produced by the residential sector would no doubt have been far higher than they currently are.⁴ Overall, it is evident that growth in the efficiency of fuel use – using less GHG-intensive energy sources, updated furnaces and improved insulation, among other factors – has been remarkable.

Natural gas is almost absent east of Ontario

The changes in energy use observed at the national level overshadow important variations at the regional level. Use of natural gas depends on the presence of pipelines. Since the 1950s, use of natural gas has grown along with the extent of the pipeline network. The small number of Atlantic Canadian households that reported using natural gas as their principal energy source reflects limited availability in those provinces.⁵ On the other hand, the majority of households in the western provinces and Ontario used natural gas as the principal energy source. Not surprisingly, virtually all households in Alberta (97%) were heated with gas.

Electricity is the leading heating source in Québec (68%), New Brunswick (56%), and Newfoundland and Labrador (50%), while oil is the leading heating source in Prince Edward Island (81%) and Nova Scotia (60%).



Wood is used in over one in seven households in the Atlantic Provinces. In 2003, wood and other solid fuels were the primary heating source for 16% of households in New Brunswick and 19% in Newfoundland and Labrador.

Apartment buildings are more likely to be heated with electricity

There are social as well as geographical dimensions to household heating. Over half (56%) of apartment buildings are heated with electricity, compared with fewer than one-quarter (23%) of houses (single detached, semi-detached, row houses and other types of single attached houses). Electric heat has advantages for landlords, since it is easier to meter individually and requires less maintenance. In contrast, 56% of houses used natural gas as their principal heating fuel, but only 34% of apartments. Oil is used by a minority of both dwelling types: 14% of houses and 9% of apartment buildings.

Since the great majority of apartment dwellers are renters (79% according to the 2001 Census), renters are about twice as likely as homeowners to use electricity, at 48% versus 25% in 2003. And with most houses being owner-occupied (86% in 2001), owners more often heat their homes with natural gas than electricity (54% versus 39% of renters).

Renters are often low-income households. Indeed, the majority (63%) of households in the lowest income quintile rent their homes, compared with only 13% of those in the highest income quintile. Consequently, sources of home heating vary across income groups.

Among households in the bottom income quintile, 44% heat their homes with electricity and 39% heat with natural gas. In contrast, among households in the top income quintile, 20% heat their homes with electricity and 67% heat with natural gas. The use of oil varied less across income groups, ranging from 10% to 15%.

Some of the interaction between dwelling type and heating source is related to social characteristics unique to certain regions as well. Quebec has the highest proportion of apartment dwellings in the country (38%) and electric heating is used in 81% of these buildings, a usage rate much higher than the national average.

Sustainability

Regional variations in energy use show that options to lower GHG emissions attributable to the residential sector must look at where real gains can be made. For example, oil is the dominant fuel in most of the Atlantic Provinces, used by about 390,000 households in 2003. Oil is used by a much smaller fraction of homes in Ontario and Québec, but these totalled over 981,000 households. Since alternative types of energy are available in these provinces (hydroelectricity in Québec and natural gas in Ontario) converting these households would have significant consequences for the quantity of GHG emissions attributable to the residential sector. Where natural gas is not easily available, these conversions would be more difficult to achieve.

Using electric heat does not have the same consequences for GHG emissions in every province. Where electricity is produced by coal or oil-fired generating plants (Ontario, Saskatchewan, Alberta, Nova Scotia and New Brunswick), the use of electricity for home heating will result in greater levels of emissions than in provinces where hydroelectricity is dominant (Québec, Manitoba, Newfoundland and Labrador, and British Columbia).

Summary

While sectors like road transportation have increasingly contributed to higher levels of greenhouse gas emissions, the same cannot be said of the residential sector. Over the last 50 years the domestic energy industry has been continuously

GST Alternative energy sources

For several decades, researchers have been investigating the development of alternative sources of energy, mainly in an effort to reduce pollution but also to diminish society's dependence on fossil fuels. Most renewable alternatives are used to generate electricity, which can then be used for household heating in addition to lighting and running household appliances. *Active solar* energy uses photovoltaic cells to convert solar energy into electricity. *Wind power* can be stored in forms other than electric cells (pumping water into reservoirs which then generate hydroelectric energy); in Europe, significant amounts of energy are being derived from wind farms – 18% of electricity in Denmark in 2003, for example.¹ *Biomass* energy uses organic waste material as fuel for power generating plants in an effort to recycle waste materials in a meaningful way. Similarly, *methane* (the principal component of natural gas) can be derived from the decay of organic material in landfill sites, where the escaping gas is captured and burned for energy. Enormous quantities of *methane hydrate* – natural gas in the form of "ice" – believed to be trapped in ocean sediments also represent an important energy resource. Unfortunately, the cost of producing energy with these methods remains a considerable barrier to their use. For example, battery technology remains fairly primitive meaning that electric batteries are still inefficient fuel sources compared with fossil fuels, and wind turbines require a lot of maintenance to operate efficiently. Similarly, the depths at which methane hydrate is found make it expensive to extract and its extreme volatility makes it dangerous to handle.

Some alternative energy sources can be used for home heating directly. Returning to the traditions of pre-20th century architecture, *passive solar* energy takes advantage of a building's site to let sunlight heat, light and cool it (cooling breezes are created by the action of solar heat on air). *Geothermal* energy can also heat homes directly by using a pump that draws heat energy from the earth or ground water.

Sources: Energy Information Administration, Department of Energy, United States Government (http://www.eia.doe.gov/cneaf/solar.renewables/page/renew_info/faq.html); Kunstler, J.H., *The Long Emergency*. Atlantic Monthly Press; New York, N.Y. 2005.

1. Kunstler, 2005: 127.

evolving. Increases in the wealth and average standard of living of Canadians have been accompanied by a constant change in household heating technology and energy sources. Canadian households, both on their own and in response to government policies, have been eager to embrace these innovations as soon as price and availability allowed. This has allowed more households to heat

themselves in a comfortable manner while greenhouse gas emissions have remained steady or even declined over the last decade.

In particular, between 1965 and 1995, the number of households in Canada using electricity for heating increased from almost zero to over 4 million, while the number using oil decreased by about 2 million. In British Columbia, Québec, Manitoba,

and Newfoundland and Labrador, where hydro-electricity is abundant, this represents a tremendous drop in greenhouse gas emissions. However, there has been almost no growth in the number of homes using electricity since 1995.

Natural gas has emerged as the home heating fuel of choice, its use constrained only by the limits of distribution networks. It is the dominant fuel in all provinces west of Quebec, and has been the only fuel whose use has grown in the last decade.

Improved efficiencies have kept greenhouse gas emissions constant over the last decade despite considerable growth in the number of households. It seems then that home heating, though an obvious policy target, may not be the best source to find major national reductions in GHG emissions. However, as illustrated by the regional differences in home heating, future improvements are still possible.

As a concluding remark, it is apparent that the home energy scene in Canada is a dynamic one. Both climate change and the ever-evolving energy supply situation will continue to pose new problems to solve. Canadian households have shown great flexibility in the last 50 years, readily adopting new technology and energy sources for home heating. This bodes well for their ability to adapt to the new energy and environmental challenges of the next half century.



Bradley Snider is an analyst with Income Statistics Division, Statistics Canada.

1. Environment Canada, "Summary: Canada's 2003 Greenhouse Gas Inventory," www.ec.gc.ca
2. Although the population doubled from 1951 to 2001, the number of households increased by over 3.5 times. This is related to the long-term decline in the number of persons per household which began in the 19th century, from 5.6 persons per household in 1881 to 4.0 persons in 1951, and down to 2.6 persons in 2001. Increasing average wealth, smaller families and a higher standard of living explain most of this decline. If average household size had remained the same between 1951 and 2001, there would be only 8 million households now, so there are about 50% more households in 2001 than would have been predicted from population change alone.
3. Environment Canada. 2005. *Canada's 2002 Greenhouse Gas Inventory*.
4. Environment Canada, 2005.
5. Natural gas pipelines are new to the Atlantic Provinces and the distribution network is not yet very extensive. The first households in Nova Scotia to use natural gas were hooked up in January 2004, and the province had 1,400 paying customers by the end of that year.