

Energy Use and Greenhouse Gas Emission Performance in Canadian Homes Since 1990

1990 - 2008 Update

May 2011



Overview

This is the third report in a series released periodically by the Canadian Home Builders' Association which examines various indicators of the environmental performance of the residential sector, and compares it with that of other sectors of Canada's economy.

Each report also discusses specific aspects of the residential sector that have relevance to energy use and greenhouse gas emissions. This edition examines the dynamic nature of Canada's housing stock, including the rate at which older homes are removed from the stock – a factor in the overall environmental performance of the sector.

As noted in previous reports, Canada's housing has achieved considerable improvement in both energy efficiency and greenhouse gas emissions. This trend has continued through the end of 2008. The actual level of improvement fluctuates from year to year, primarily in response to variability in annual weather conditions, as some 60% of all residential energy use is tied to space heating.

When looking at the trend data for the period from 1990 to 2008 it is noteworthy that efficiency improvements have occurred in both existing and new construction. Between 1990 and 2008, some 4.4 million new homes were built – resulting in a 33% net increase in the number of homes in Canada. Over the same period, total residential energy use grew by only 14.3%. While new homes are considerably more energy efficient than older homes, the impact of retrofitting and equipment upgrades in the older stock has been considerable.

Greenhouse gas emissions from Canadian homes during the period rose by only 0.3%, in sharp contrast to increases in many other sectors of the economy. The very positive greenhouse gas emission performance of the housing sector is made even clearer when compared to that achieved by the commercial/institutional building sector, which grew more slowly than housing, but saw its greenhouse gas emissions increase by over 36%.

There are many factors at play in the positive environmental performance of the residential sector. New homes are more energy efficient than older homes. Most household appliances and fuel-fired residential heating equipment have seen significant increases in efficiency. Homeowners continue to invest in improving the energy efficiency of existing homes. And a significant number of older, less energy efficient homes have been removed from the housing stock.

On balance, all of these factors play a role in making the residential sector a leader in energy efficiency and greenhouse gas emission reduction.

Notes on the Data

All data presented in this report was sourced or derived from the *Comprehensive Energy Use Database* developed and maintained by the Office of Energy Efficiency, Natural Resources Canada (NRCan), 2010 release, which currently includes data to 2008. The CEUD can be accessed at: <http://oee.nrcan.gc.ca/corporate/statistics>. The CHBA thanks NRCan for maintaining, and making available, this important information.

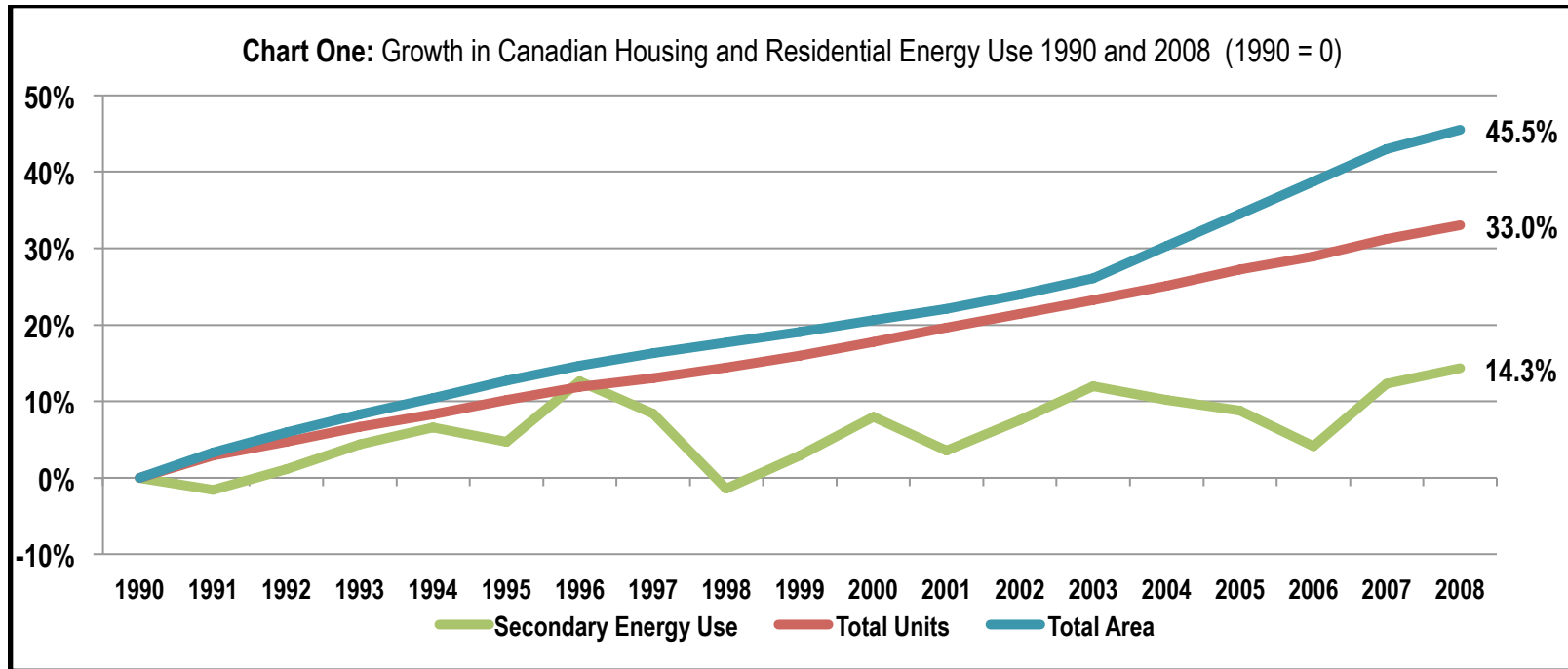
In relation to greenhouse gas (GHG) emissions, some additional details need to be understood.

With the exception of data presented in Charts Two and Three, the greenhouse gas emission data used in this report does not include emissions resulting from the generation of electricity. In all other charts, GHG emission represents *secondary energy use* – the energy actually consumed in homes. This treatment, which is consistent with NRCan reporting practices and international protocols, recognizes that electricity presents specific challenges when assessing the environmental performance of end-users. Some provinces, including Québec, Manitoba and British Columbia, produce electricity from sources that result in little, or no, GHG emissions (e.g., hydro electric and nuclear plants). Other provinces, including Alberta, Saskatchewan and Nova Scotia rely on extensive use of fuel-fired electricity generation (e.g., coal- and oil-fired plants), resulting in moderate to high GHG values for electricity.

GHG emissions resulting from electricity generation are rightfully the responsibility of the utility and the jurisdiction, where this occurs. New home builders, and homeowners, have little or no control over the generation mix by electricity producers.

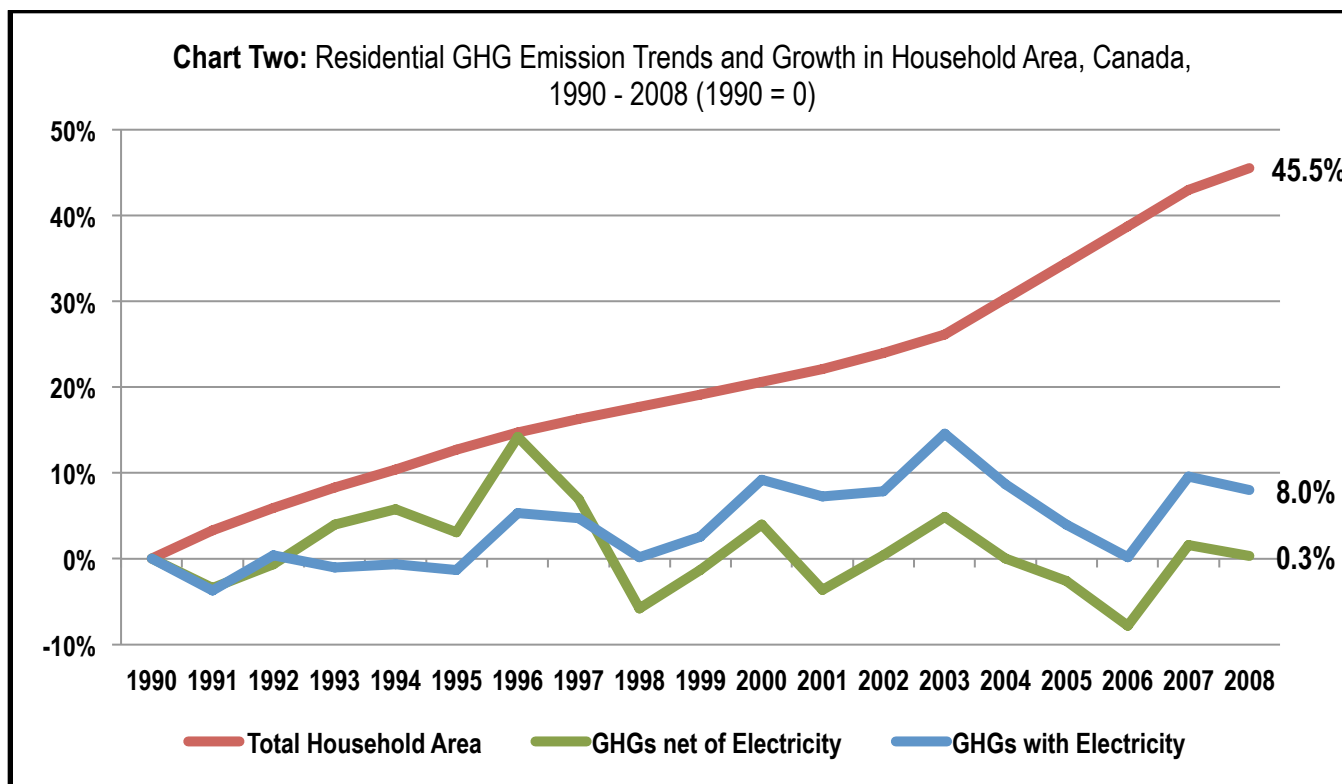
Readers should also be aware how energy sourced from wood and biomass is treated in relation to GHG emissions. Under international protocols, biomass-based energy is zero-rated in terms of GHG emissions, as it represents both a GHG source and sink. While Canada is a highly urbanized nation, biomass remains a significant, and growing, source of residential space heating energy, contributing about 11% of the total space heating load on a national basis. The level of residential wood/biomass use for space heating varies considerably provincially, from a low of 0.3% in Alberta to a high of 26.8% in New Brunswick. Given that space heating represents almost two-thirds of all residential energy use, the use of wood fuels has significant impacts in terms of residential GHG emissions in some provinces.

Growth in Housing and Residential Energy Use



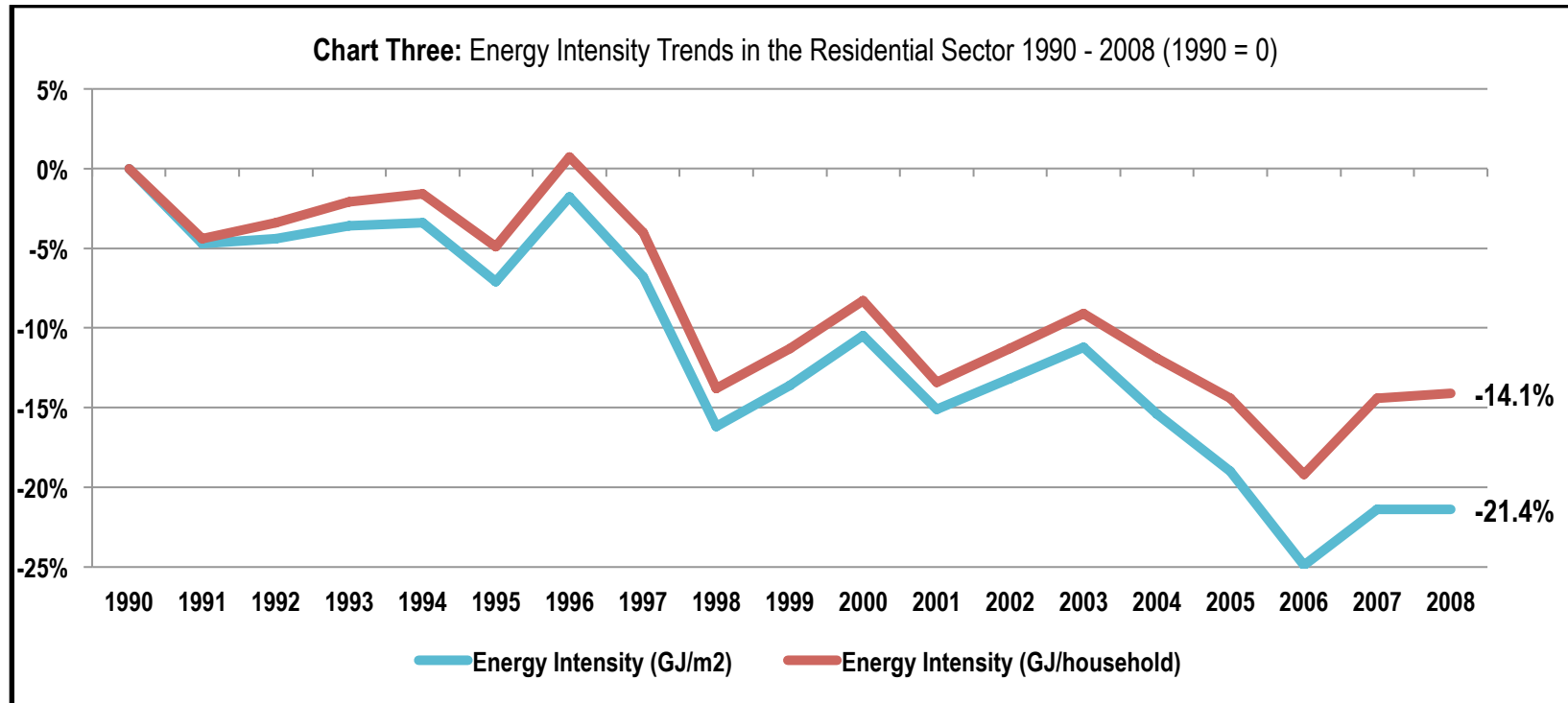
Unlike many other sectors of the Canadian economy, growth in the residential sector continues to take place without a proportional increase in energy use. Between 1990 and 2008, there was a 33% increase in the total number of household units, and a 45.5% increase in total floor area. Over this period, total residential energy use increased by only 14.3%, reflecting ongoing energy efficiency gains in existing housing, and the effect of higher efficiency in new construction, and a number of other factors. Annual variation in total energy use in homes is primarily linked to weather effects (see Charts Nineteen and Twenty).

Greenhouse Gas Emission Trends



Over the reporting period, residential greenhouse gas emissions (GHG), net of those related to electricity production, were largely unchanged. Factoring in electricity-related emissions, there was an 8% increase. During the same period, the total floor area of the residential sector grew by 45.5%. The divergence between growth in the residential sector and GHG emissions is linked to a number of factors, including efficiency gains in homes, heating equipment and other appliances, as well as the effects of fuel-switching and stock removal. As noted previously, year-to-year variability in household energy use and GHG emissions is primarily linked to weather effects.

Energy Intensity Trends



Energy intensity, which tracks the amount of energy used per housing unit and per square metre of housing, offers the best indication of overall energy performance changes through the reference period. These two values are provided in Chart Three.

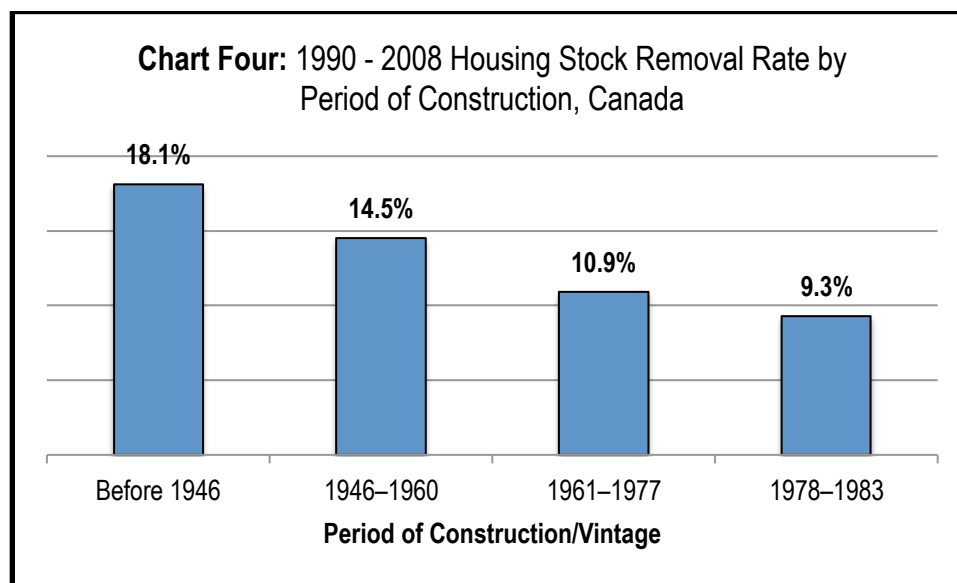
In relation to housing units, energy intensity per home has fallen 14.1%, representing an equivalent improvement in energy efficiency.

In relation to total area of the housing stock, energy intensity has fallen by 21.4%.

These two energy intensity values diverge because the average area of homes built between 1990 and 2008 was greater than that of the average pre-1990 home.

The Dynamic Nature of Canada's Housing Stock

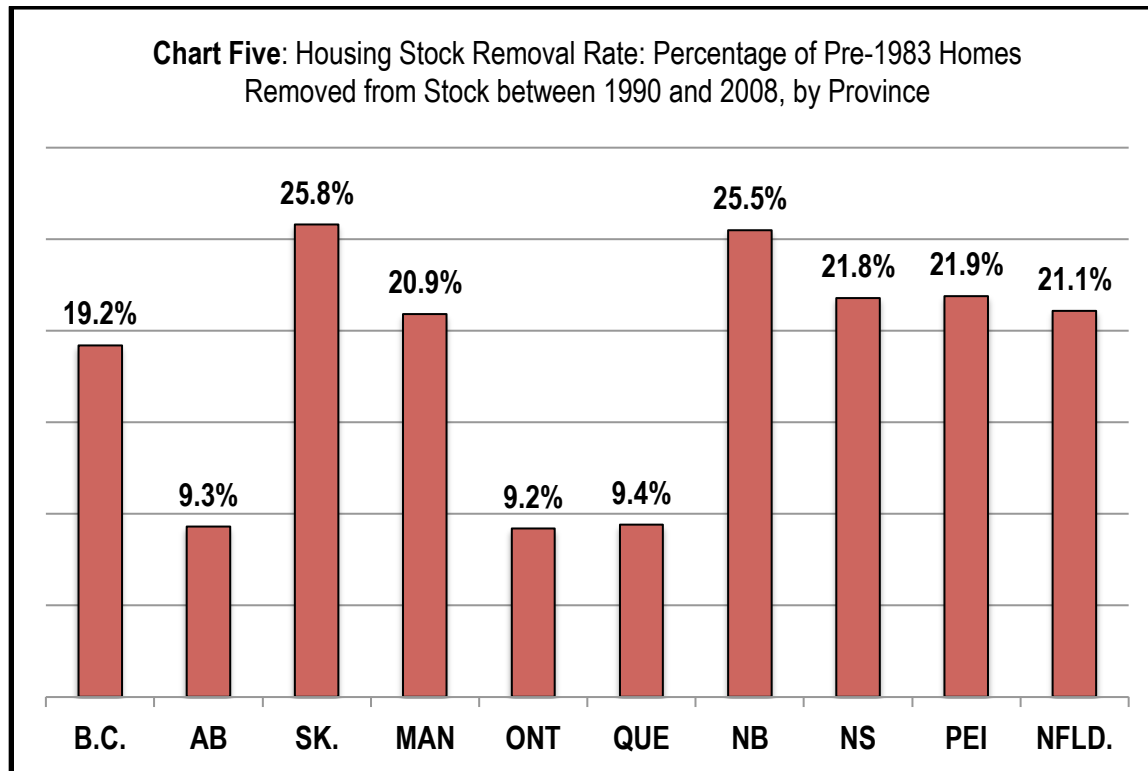
In considering the environmental performance of homes, it is most common to focus on two variables: the energy efficiency of new houses, and energy retrofit activities occurring in existing homes. While important, these two factors represent only a part of the story. The housing stock is dynamic – just as new homes are built and existing homes are improved each year, a significant number of older homes are also removed from the stock. This can involve older homes that are replaced by newer units for economic reasons (e.g., in-fill and re-development), or homes that are abandoned or demolished due to shifting demographics or deterioration (likely more common in rural and agricultural areas). In either event, homes removed from the stock tend to be older, and are likely among the least energy efficient.



At a national level over the report period, the rate of removal of homes built in 1983 or earlier was about 0.7% per year, or 13% in total. As illustrated in Chart Four, this rate varied by the vintage, or period of construction, of the homes. Those built before 1946 had the highest removal rate, with more recently-constructed homes experiencing a much lower removal rate.

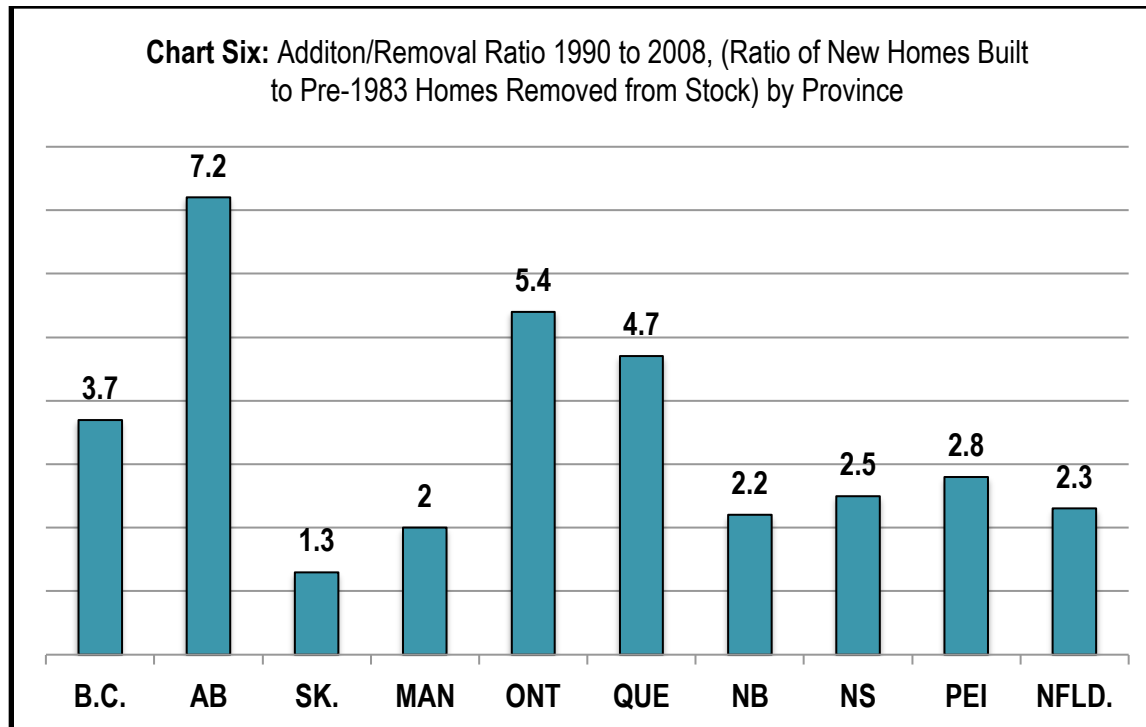
In considering the impact of stock removal on the environmental performance of housing, it is important to note that the stock removal rate also varied considerably across the country, as illustrated in Chart Five on the following page.

Across the provinces, the housing stock removal rate for pre-1983 homes was quite varied between 1990 and 2008. In two provinces, the removal rate exceeded one-quarter of the oldest stock, which appears to have had a notable impact on the average energy performance of the remaining stock.



Removal/New Construction Ratio

Another environmentally-relevant metric is the ratio of new home construction to older stock removal. This provides insight into the dynamic changes taking place in the stock, and its variability across the country. At the national level, this ratio was 4.0 for the 1990 – 2008 period: for every older home removed from the stock, four new homes were built. In total, this represents some 4.4 million new homes coming into the stock, and just over 1.1 million older homes being removed from residential use.



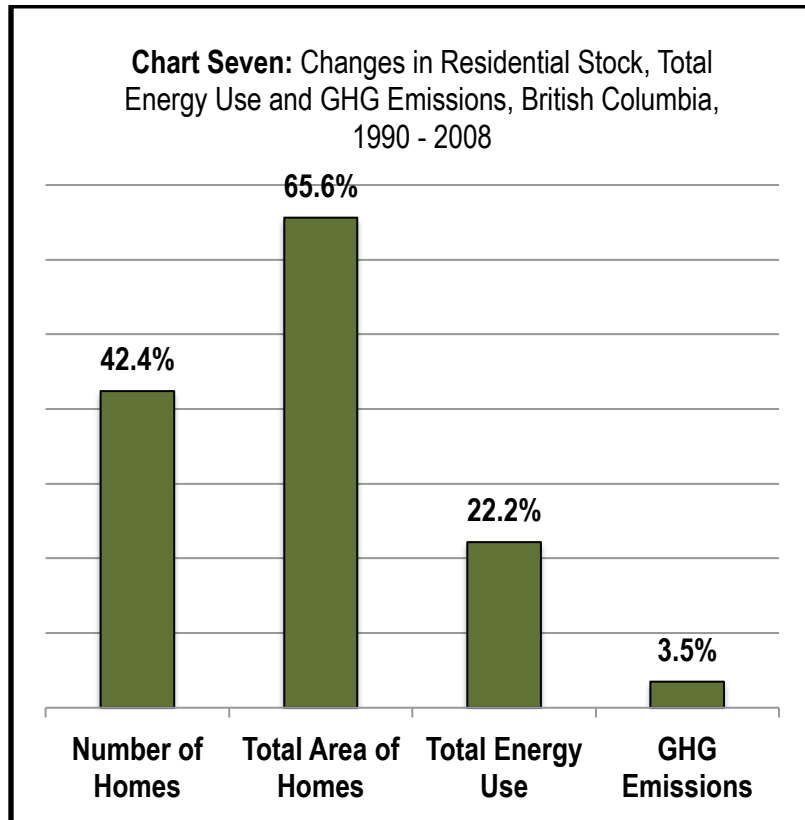
The ratio was highest in those provinces that have seen strong housing growth through the period: Alberta, Ontario, Quebec and, to a lesser extent, British Columbia.

In environmental terms, the amount of energy required by the residential sector is influenced by this ratio. In provinces with a low ratio, residential energy requirements will tend to fall. In those with the highest ratio, it will increase.

Provincial Trends

The following pages present environmental performance results by province for the period of 1990 to 2008. For each province, data are reported for the changes in the total number of homes, the total area of homes, the total energy used by all homes in the province, and the related greenhouse gas emissions from this energy use. The percentage values correspond with the net change in each value over the 18-year period.

British Columbia



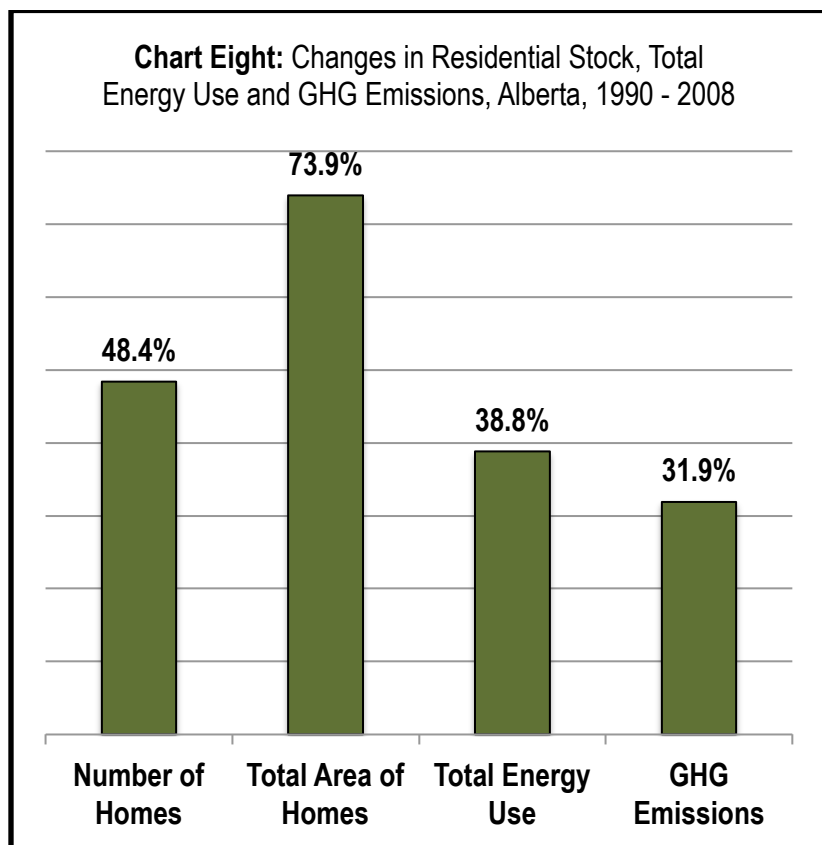
British Columbia saw strong growth in the number and area of homes over the period – 42.4% and 65.6% respectively. Total energy used in homes grew at about half the rate of home growth, and about one-third on a net area basis.

Greenhouse gas emissions from homes grew at a very low rate – 3.5% over the period. This reflects changes in the energy mix: the share of electric space heating in B.C. grew from 18.5% in 1990 to 28.7% in 2008. During the same period, the space heating share of heating oil fell from 12.7% to just 0.9%. Natural gas, with a 58% market share, remained largely unchanged over the period.

It is also worth noting that wood contributes just over 10% of all space heating energy used in B.C. homes.

B.C. also saw a fairly high older stock removal rate during the period, with over 19% of pre-1983 homes being removed from residential use. This change will have contributed somewhat to the lower growth in energy demand by the province's residential sector.

Alberta



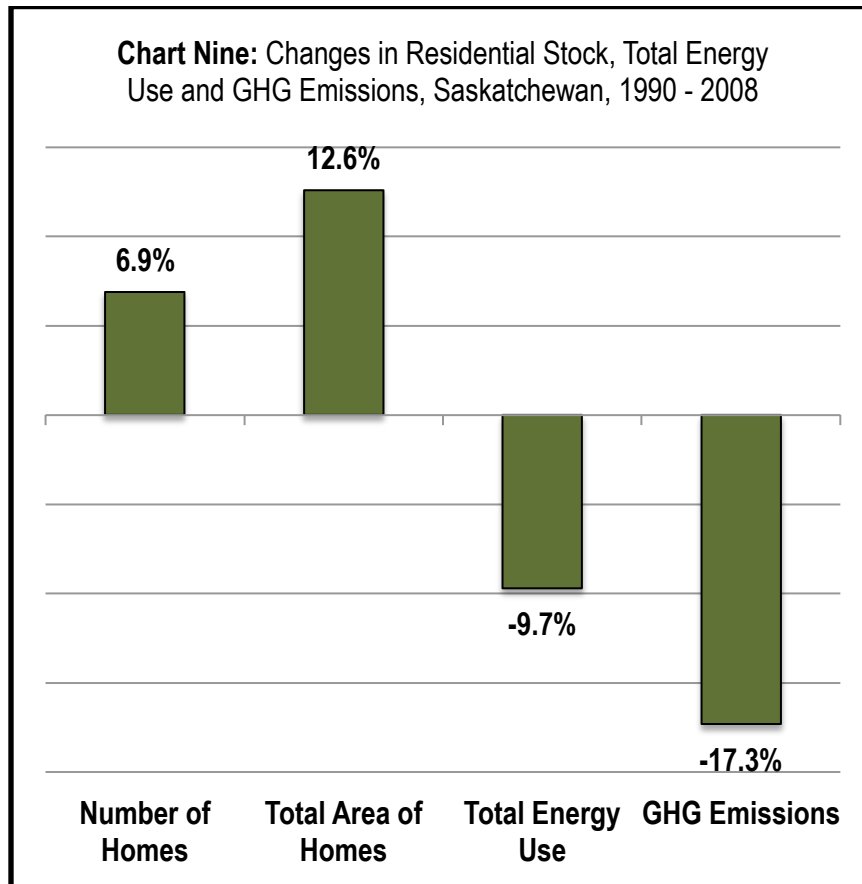
Between 1990 and 2008, Alberta led the country in terms of new housing, as a percentage of total housing stock, with nearly a 50% increase in the number of units, and over 70% growth in the total area of housing.

Unlike the other prairie provinces, there was relatively less stock replacement in Alberta. Over the reporting period, some 9.3% of pre-1983 homes were removed from use, considerably lower than in either Saskatchewan or Manitoba. Overall, some 77,000 older homes were removed, and 558,000 new homes built.

The energy mix in the residential sector remained quite steady in Alberta. In terms of space heating, natural gas went from a 91% market share to nearly 96%. Electricity use for space heat remained at 5%, and the use of heating oil fell from 1% to nearly zero.

Due to the lack of significant performance impacts from these factors, the overall performance of the residential sector in Alberta was closely aligned with changes in the average energy efficiency of new and existing homes. Here, Alberta achieved a modest 6.5% improvement in the energy intensity of homes, less than half the national average improvement of 14.1%. As a result, given the overall growth in housing stock, total energy use in homes grew by 38.8% and residential GHG emissions increased by nearly 32%.

Saskatchewan



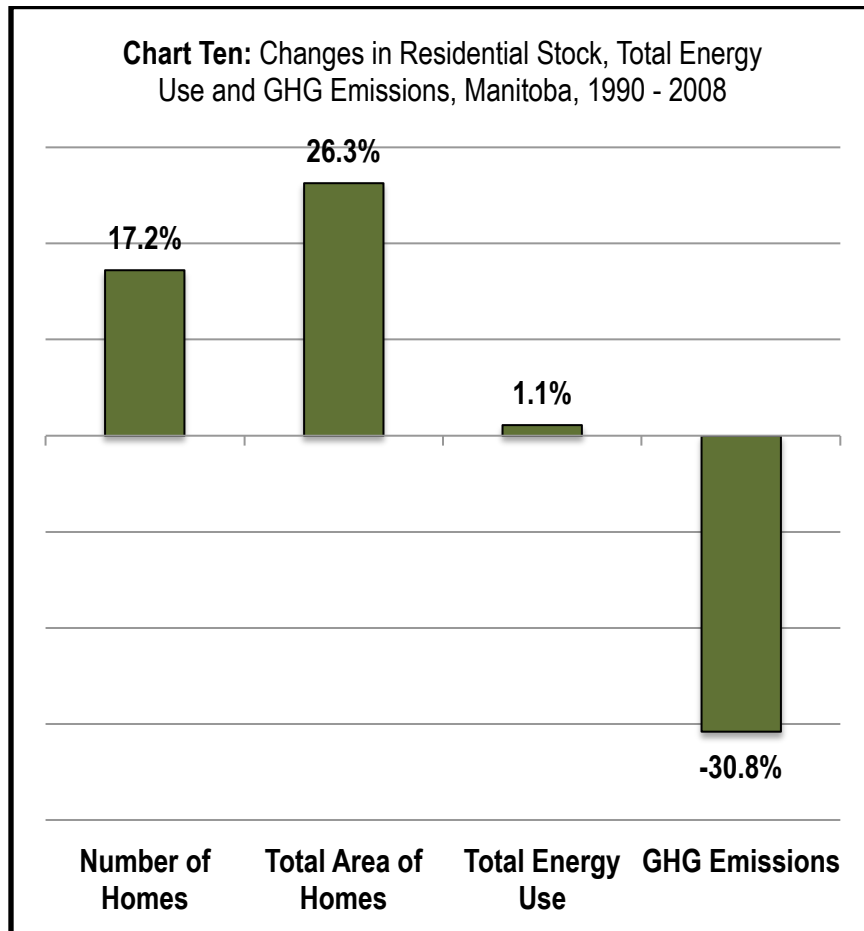
Environmental performance results for Saskatchewan are of particular interest. While the change in the net number of units over the reporting period is quite modest, this obscures a significant change in the composition of the stock.

Between 1990 and 2008, 113,500 new homes were built in the province. During the same period, some 85,000 homes constructed in 1983, or earlier, (the least energy efficient homes in the province) were either abandoned or demolished, and no longer in residential use. This represents just over one-quarter of the oldest homes in Saskatchewan.

This process of unit replacement resulted in significant improvement in the energy performance of the overall housing stock – total residential energy use fell by nearly 10%, and greenhouse gas emissions fell by over 17%.

Over the period, natural gas remained the dominant energy source for residential space heating, with an 80% share. In contrast, the use of heating oil fell from 7.6% in 1990 to only 1.1% in 2008, which also contributed to reduced GHG emissions.

Manitoba



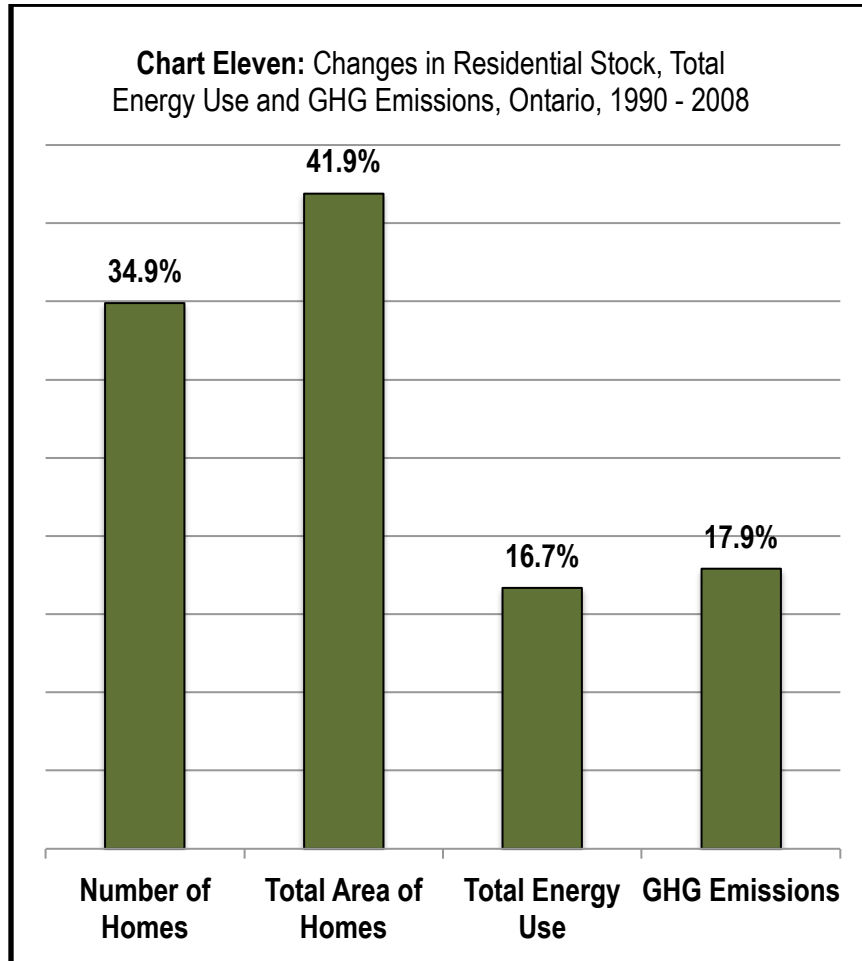
Manitoba, like Saskatchewan, experienced significant change in the composition of its housing stock over the period. In Manitoba, just over 20% of the pre-1983 housing stock was removed from use between 1990 and 2008, some 70,000 units in total. During the same period, 138,800 new homes were built.

The net increase in the number of homes of 17.2% resulted in only a 1.1% increase in total energy use, and a 30.8% decrease in residential GHG emissions.

In addition to changes in the housing stock, GHG emissions performance was aided by significant changes in the type of energy used in Manitoba homes.

Electric space heating increased its market share from 21.3% to 40.2% over the period. The use of heating oil fell from a 6.2% market share to only 0.2%. Natural gas also fell from a 65% market share to just over 50%.

Ontario



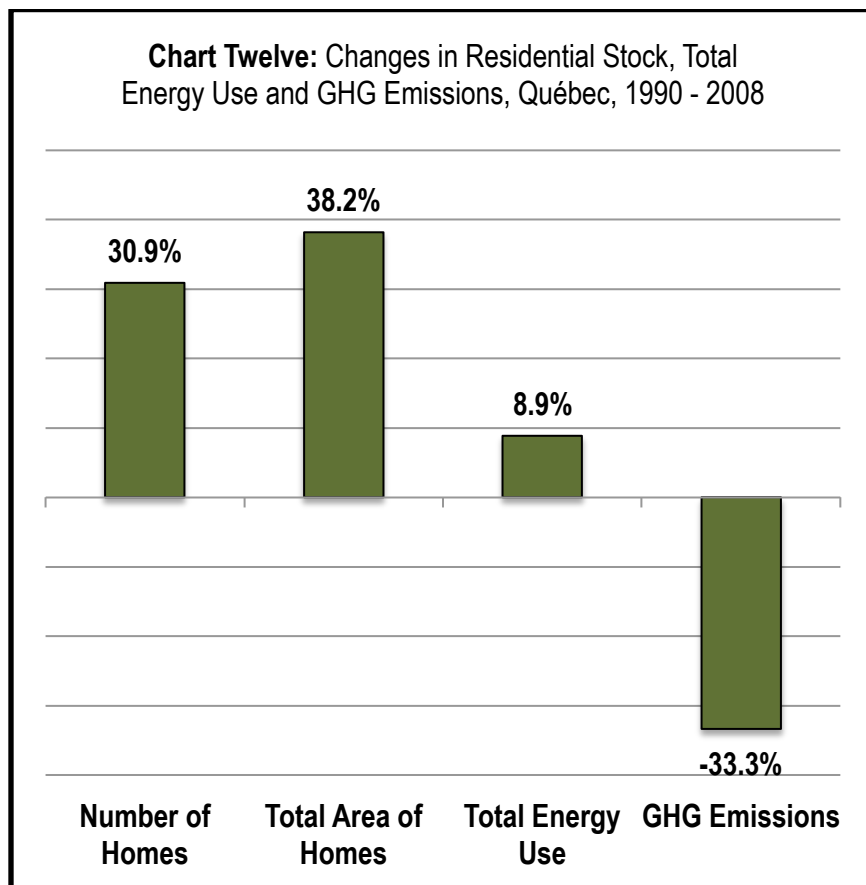
Ontario experienced strong housing growth through the reporting period, with 34.9% growth in the stock.

Total energy use in homes grew at about one half this rate – 16.7%. GHG emissions grew by a similar amount.

Ontario had the lowest provincial rate of removal of older homes, at 9.2%, which likely impeded overall efficiency gains in the stock. The ratio of new construction to stock removal was also quite high, which put added pressure on energy demand.

In terms of the residential energy mix in Ontario, there was relatively less change than in most other provinces. The share of space heated provided by electricity remained stable, at 15.4%. The space heating market share of natural gas grew from 60% to 72.5%, Heating oil use fell from 16.2% to only 3.6%. Wood heating use grew slightly, but at 6.1% of total space heating energy, remains quite low.

Quebec



While Québec experienced growth in housing stock that was similar (if slightly lower) to that in Ontario, the environmental outcomes were quite different – total energy use grew by less than 10%, and GHG emissions were reduced by one third.

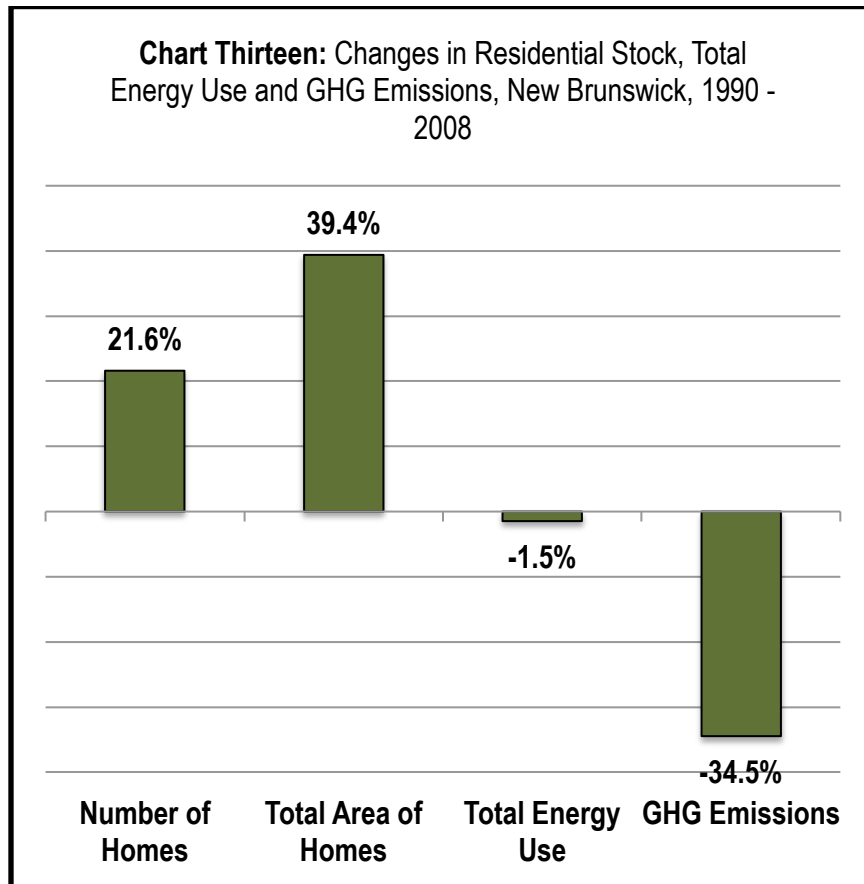
This is not tied to the rate of removal of older homes in the province, as it was quite low and in line with Ontario results.

However, Québec saw significant shifts in the fuel mix for residential space heat over the period, which contribute to higher overall efficiency and reduced GHG emissions.

The share of residential space heating provided by electricity grew from 39.9% to 54.2%. The natural gas market share shrank from 9.2% to 7.9%. Heating oil market share fell by more than half, from 29.6% to 13.4%. The space heating market share for wood fuels grew from 20% to 24%.

Overall, this means that nearly 80% of Québec's residential space heating energy use results in no reportable GHG emissions. (Québec's electricity system is carbon-free.)

New Brunswick



New Brunswick saw modest growth in its housing stock over the reporting period, but achieved an overall reduction in residential energy use, and a very significant reduction in residential GHG emissions.

There appears to be a number of factors that contributed to this environmental outcome.

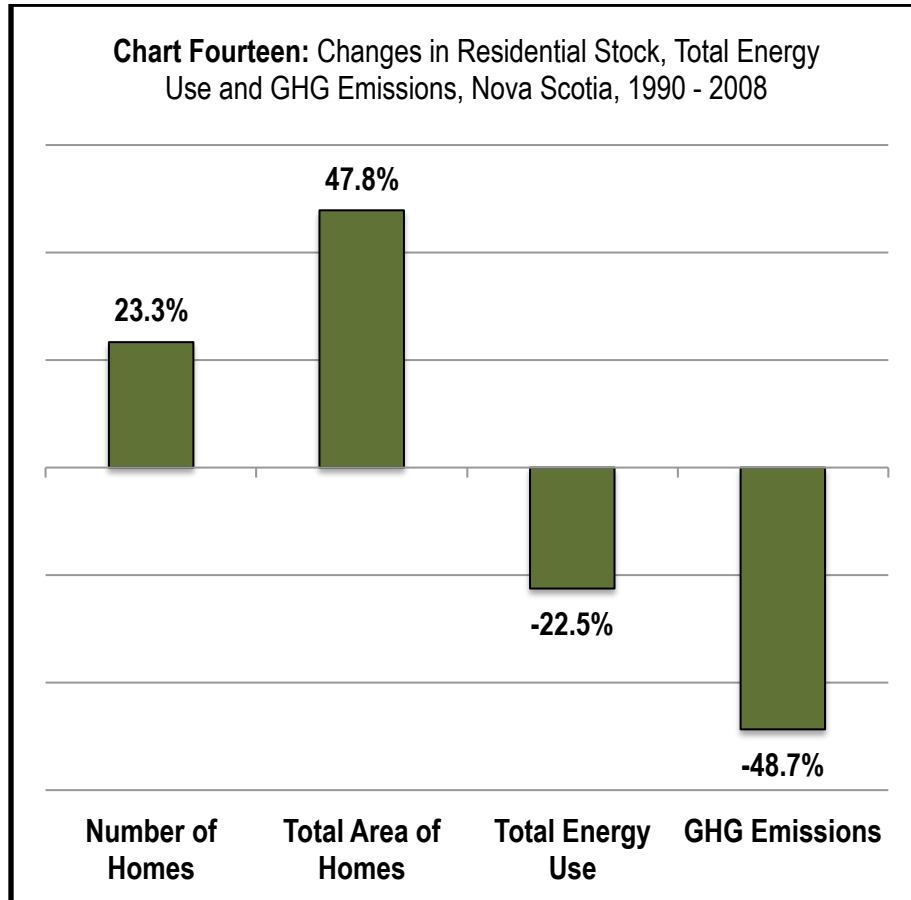
First, the removal rate for older homes from New Brunswick's housing stock was very high – 25.5%. As well, the data suggest that there has been a significant level of energy retrofit activity in the remaining existing stock.

Second, the energy mix for residential space heating has seen some significant shifts since 1990.

Electrical space heating has seen its market share grow from 30.3% to 44.5%. The share for heating oil has fallen by almost half, from 46.5% to 23.3%. And wood heating accounts for 26.8% of the residential space heating load – the highest rate in the country.

Natural gas, which was introduced in the province in the mid-1990s, had a 4.4% market share in 2008.

Nova Scotia

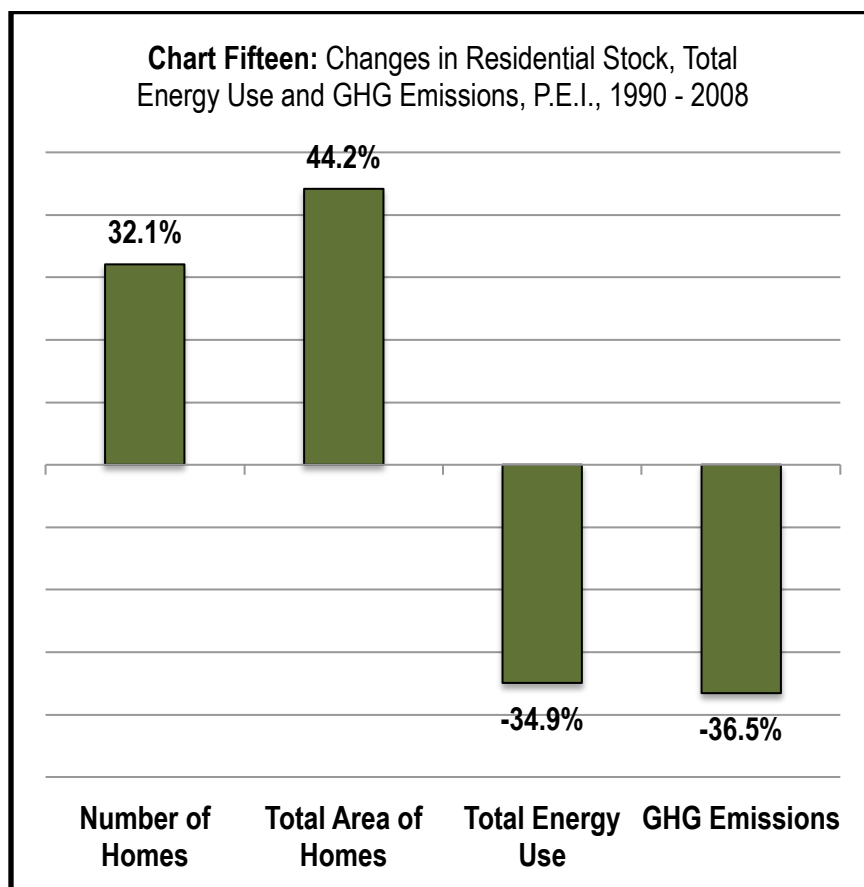


Nova Scotia continues to lead the country in terms of reduced residential GHG emissions, which fell over the reporting period by nearly half. Total residential energy use also fell significantly, by 22.5%.

Like New Brunswick, there appear to be a number of factors behind these shifts. About 22% of the province's older homes were removed from the stock over the reporting period. The data also suggest significant energy retrofit activity in the remaining stock of older homes.

In relation to the residential fuel mix for space heating, electricity has seen a doubling of market share, from 12.8% to 28.4%. Heating oil has fallen from 70.6% to 44.2%. In 2008, wood space heating accounted for 22.2% of space heating, nearly double the level in 1990.

Prince Edward Island

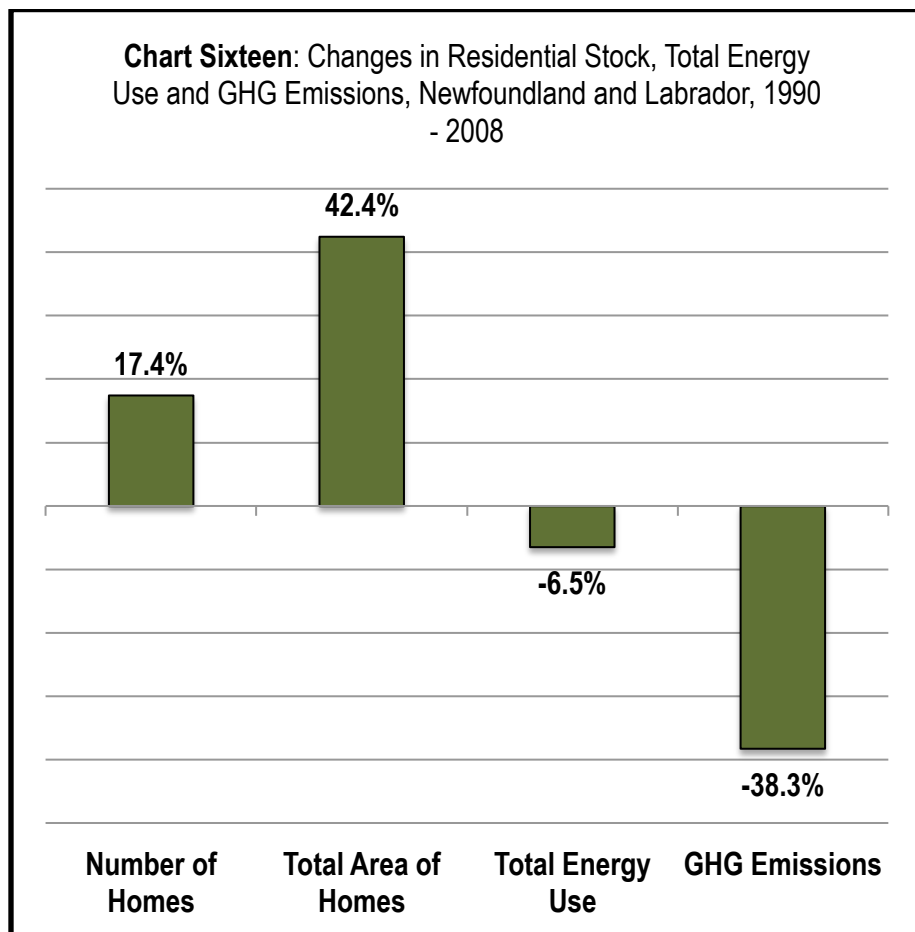


Environmental data on the residential sector in P.E.I. has been somewhat anomalous in the last number of years, and should likely be viewed with caution. The apparent 34.9% drop in total residential energy use has no obvious explanation, and would have to reflect an extraordinary level of energy retrofit activity.

The removal rate for older homes in P.E.I. was nearly 22%, which should account for some performance improvement in the remaining stock.

There were few changes in the energy mix for residential space heating over the period, with heating oil remaining the dominant source with a 76.7% market share. Electricity, which is very expensive on the Island, holds only a 4.4% market share, and wood heating accounts for an additional 13.3% of residential space heating.

Newfoundland and Labrador



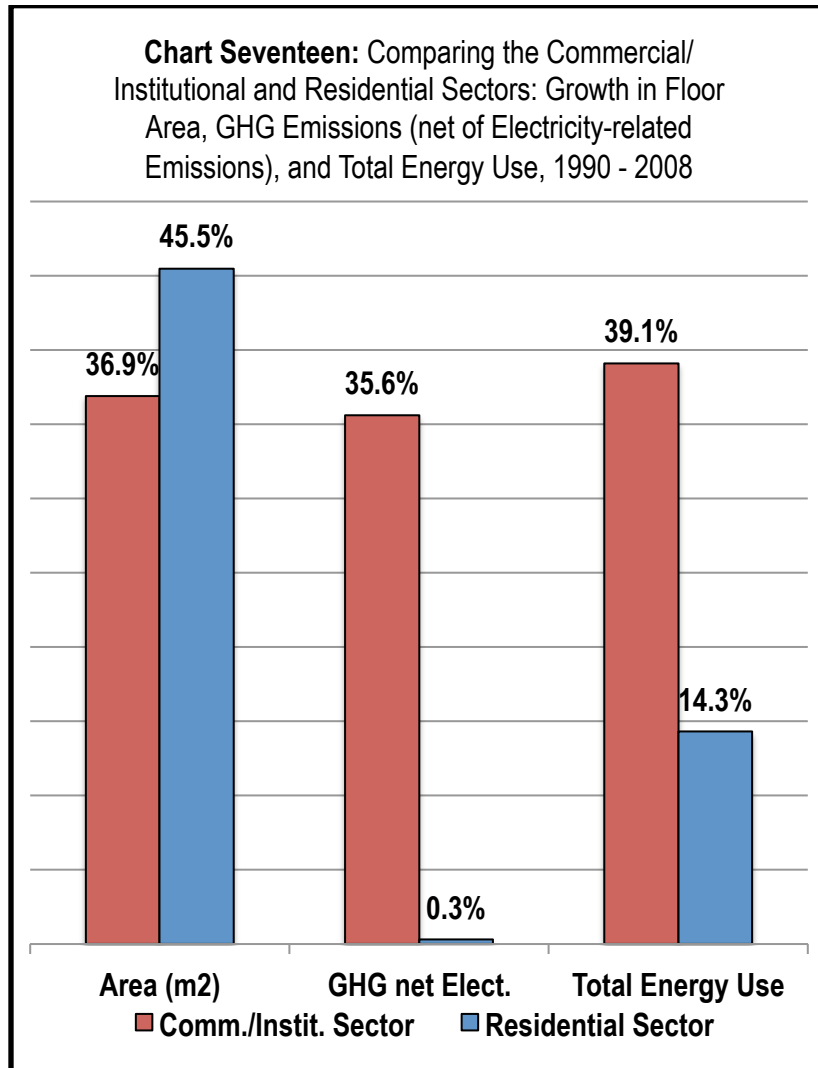
Environmental results for the residential sector in Newfoundland and Labrador bear similarities with Nova Scotia and New Brunswick.

The removal rate for older homes over the reporting period was similar, at just over 21%.

In terms of the space heating fuel mix, the market share for electricity nearly doubled, from 26.8% to 48.4%. The use of heating oil fell from 47% to 29.2%. Wood fuel accounted for some 20.5% of total residential space heating.

As in the other Atlantic provinces, the data suggest that a significant level of energy retrofitting in existing homes has also taken place.

Comparative Performance of the Residential and Commercial/Institutional Buildings Sectors



As shown in Chart Seventeen, when comparing the residential sector with the commercial/institutional sector, it is clear that there has been a marked difference in performance outcomes through the reporting period.

Overall sector growth, as measured in m², has been higher in the residential sector. Yet both GHG emissions and total energy use have grown at a far lower rate in homes than in commercial and institutional buildings.

In addition, as indicated in Chart Eighteen, on the following page, it is also quite clear that energy efficiency took root in the residential sector well ahead of the commercial/institutional sector.

Multi-Sector GHG Emission Trends

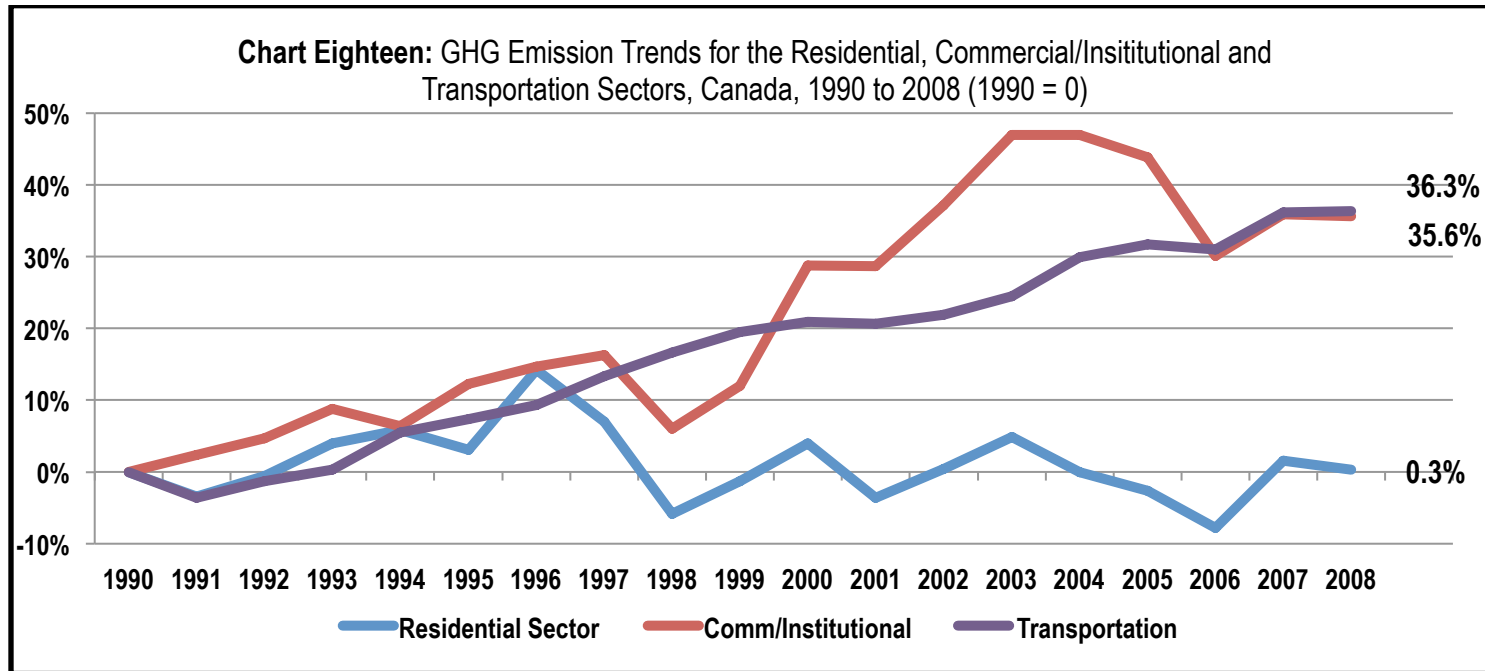
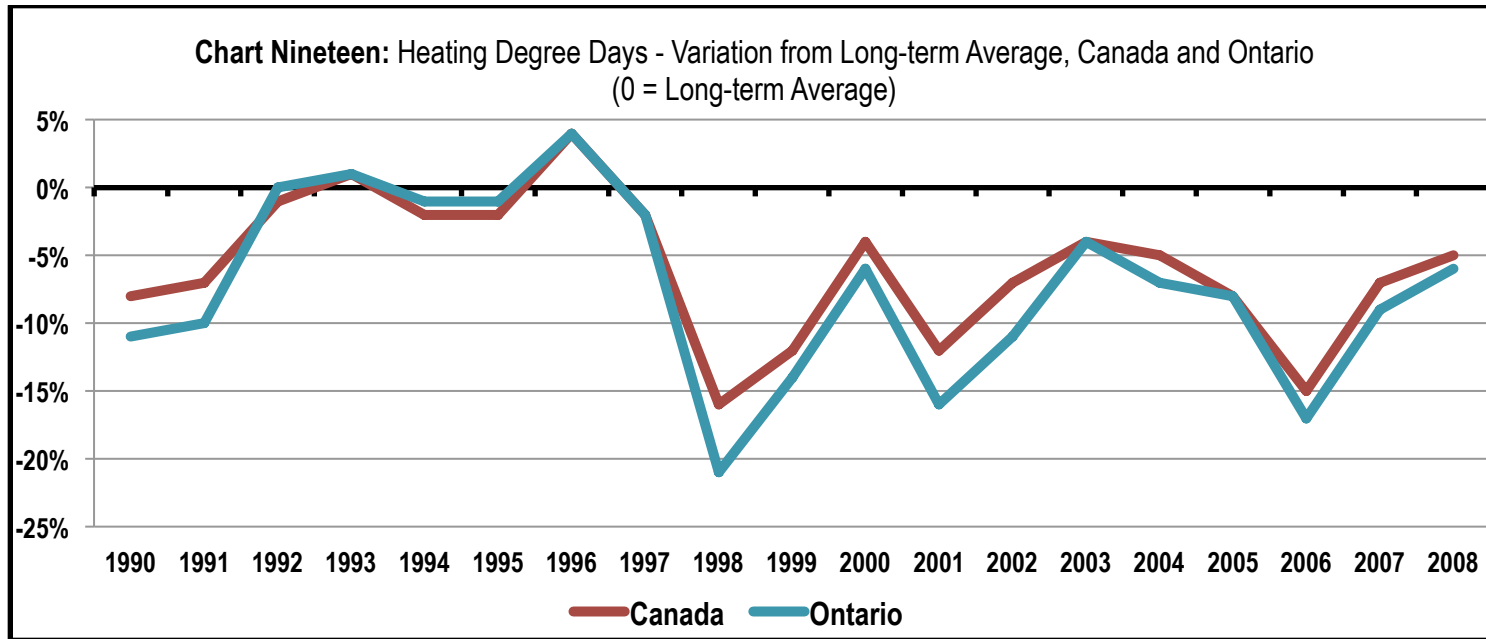


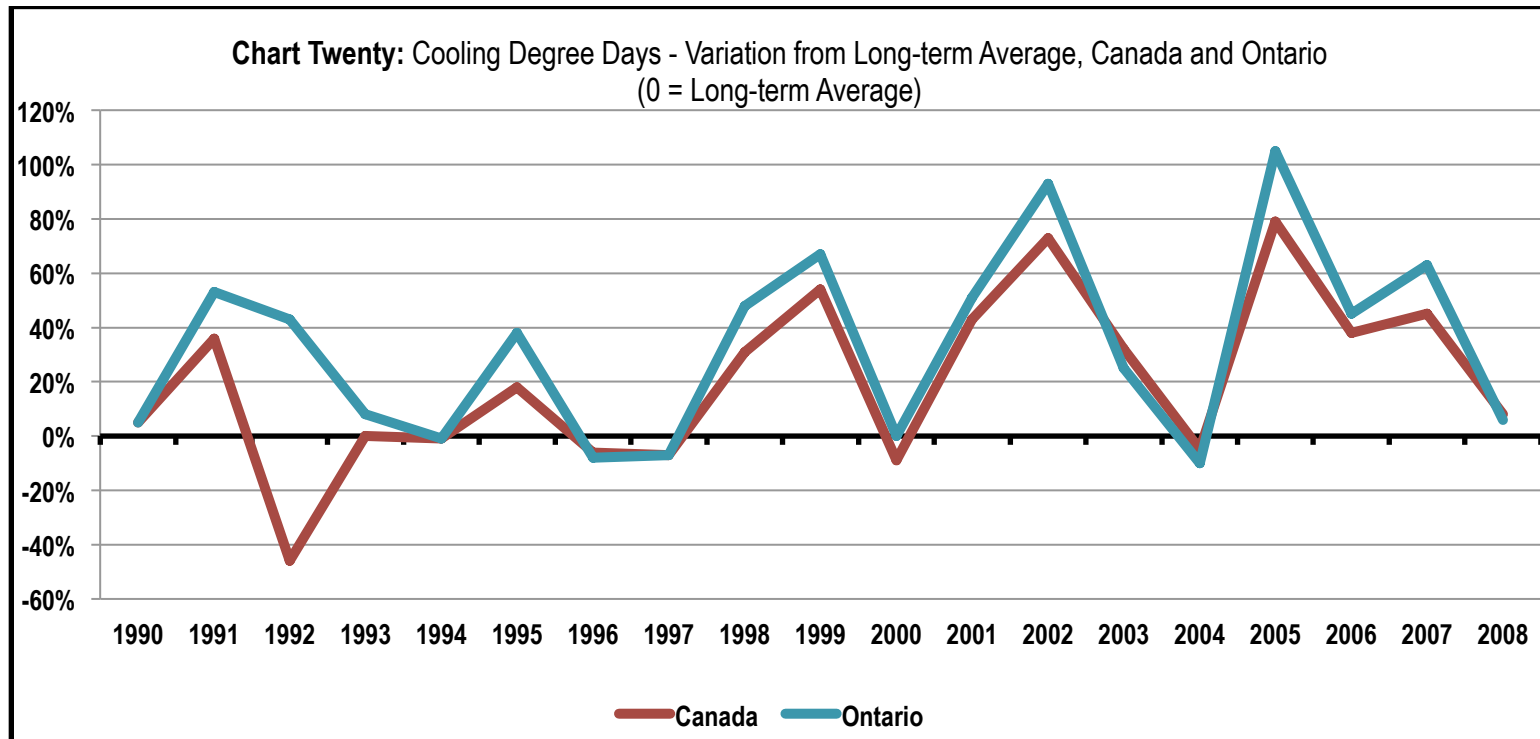
Chart Eighteen tracks GHG emissions in three sectors: residential housing, commercial/institutional building and transportation. The data illustrate several of significant trends. First, it is clear that energy efficiency gains began in the residential sector well ahead of the commercial/institutional sector. Second, total growth in GHG emissions in transportation have continued to grow at a steady rate, despite improvements in vehicle fuel efficiency.

Climate Factors – Heating Degree Days



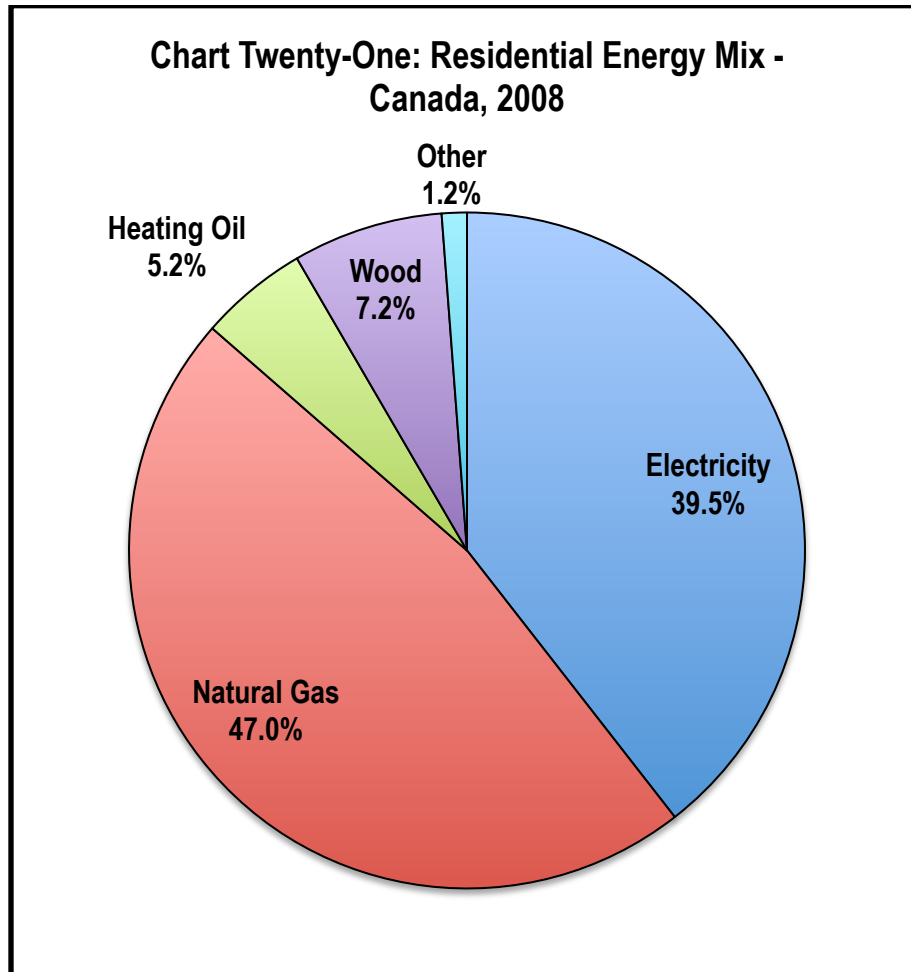
It is generally agreed that climate change is already having an impact on annual weather patterns in Canada. Chart Nineteen tracks the annual heating degree days in Canada and Ontario (daily temperatures below 18° C.) against the long-term average for the country (represented by the zero line). Annual Heating Degree Days below zero indicate warmer than average winter conditions. As the Chart illustrates, over the reporting period, there was a pronounced trend to warmer winters, this trend was more pronounced in Ontario.

Climate Factors – Cooling Degree Days



Another aspect of a changing climate that is affecting residential energy use relates to space cooling. Cooling Degree Days is a measure of how warm the summer months are. As indicated in Chart Twenty, over the reporting period most years had significantly higher-than-average Cooling Degree Day totals. This directly affects energy use for space cooling. Combined with the data on Heating Degree Day trends, it is clear that Canada is experiencing both warmer winters and summers, and that this trend is somewhat more pronounced in Central Canada.

Trends in the Residential Energy Mix



Over the reporting period, there has been a gradual shift in the mix of energy sources used in the residential sector. Chart Twenty-One presents this energy mix for 2008.

When compared with the energy mix in 1990, a number of significant shifts are evident.

- The share for natural gas has grown from 41.2% to 47.0%.
- Electricity use has increased from 36.5% of the total, to 39.5%
- The use of heating oil has fallen quite drastically, from 14.5% of total residential energy use in 1990, to 5.2% in 2008.
- The use of wood-based fuels (e.g. firewood, wood pellets) has increased over the period, from 6.1% to 7.2% of total residential energy use. There is tremendous variability in the use of wood as a residential energy source; in New Brunswick it accounts for over 18% of the mix.
- Nationally, wood accounts for about 11% of total residential space heating energy use.
- Other fuel sources (primarily propane) remain minor contributors to the residential energy mix.