Chapter 3: Residential sector

Overview – Residential energy use and GHG emissions

In Canada, 78 percent of all residential energy use is for space heating and water heating.

In 2005, Canadians spent $26.8 billion on household energy needs. Total household energy use was 17 percent of all energy used and 15 percent of all GHGs emitted in Canada. The energy used was 1402 PJ and 73.8 Mt of GHGs were emitted by the residential sector.

In 2005, average household emissions were equivalent to the emissions of the average number of vehicles per household (1.3 light-duty vehicles). This contrasts with 1990 when the average household had emissions equivalent to 0.9 light-duty vehicles.

Figure 3.1 Energy use by sector, 2005 (percent)

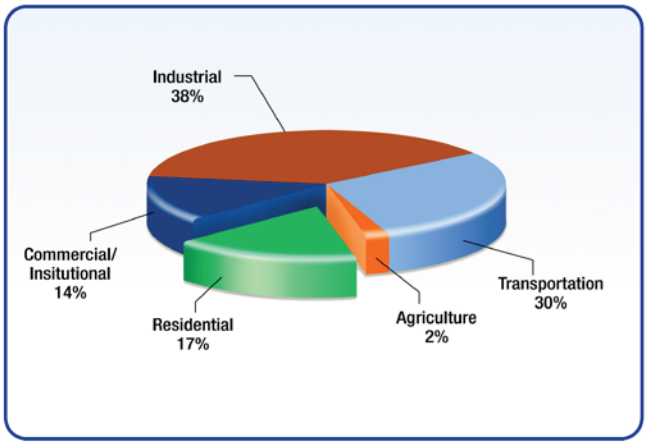
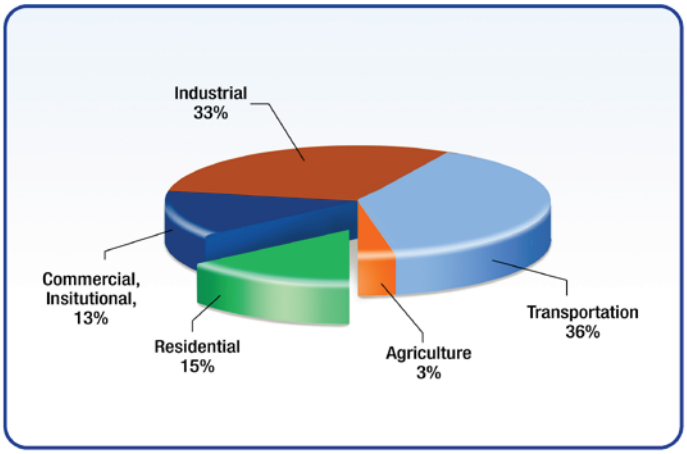
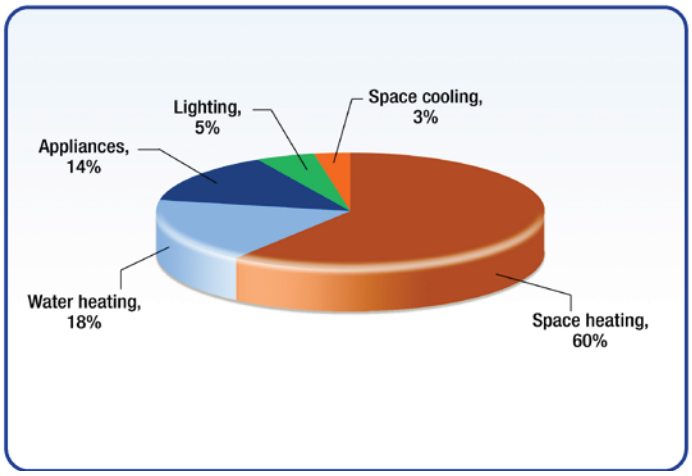


Figure 3.2 GHG emissions by sector, 2005 (percent)



Natural gas and electricity together accounted for 85 percent of all residential energy use in 2005. Wood, heating oil and propane were the other sources of energy being used. Within a household, these forms of energy were used for a variety of activities, as seen in Figure 3.3. Space and water heating account for the majority of Canada's residential use (78 percent), followed by appliances, lighting and air conditioning.

Figure 3.3 Distribution of residential energy use by end-use, 2005 (percent)



Trends – Residential energy use and GHG emissions

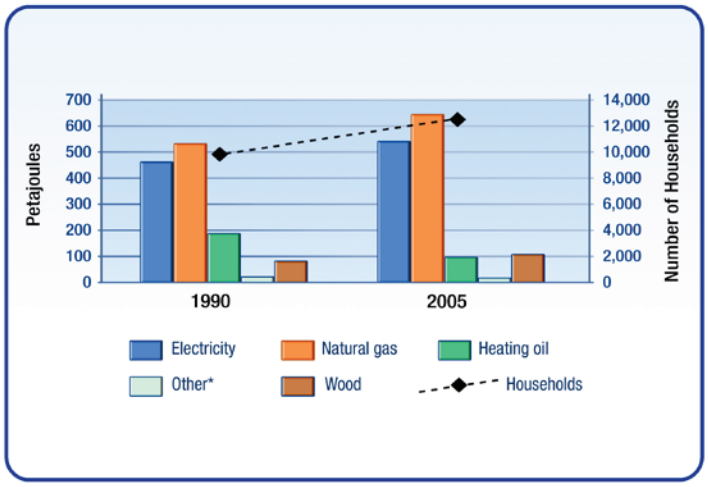
Population growth and fewer people per household stimulated a rise in the number of households and a 9 percent increase in residential energy demand from 1990 to 2005.

Between 1990 and 2005, residential energy use increased 9 percent or 116 PJ, from 1286 PJ to 1402 PJ. The associated GHG emissions grew 6 percent, from 69.4 Mt to 73.8 Mt. During the period, the population grew 17 percent (4.6 million people) and housing stock grew 27 percent (2.7 million households).

The 2.7 million households added in Canada since 1990 was significant and represented more than the number of households in Quebec in 1990 or three times the number of households in Alberta in 1990.

The mix of energy used in the residential sector has changed slightly over the period. Specifically, natural gas and electricity have become even more dominant and heating oil use has declined. These increases were largely the result of increased availability of natural gas and lower natural gas prices relative to oil.

Figure 3.4 Residential energy use by fuel type and number of household, 1990 and 2005



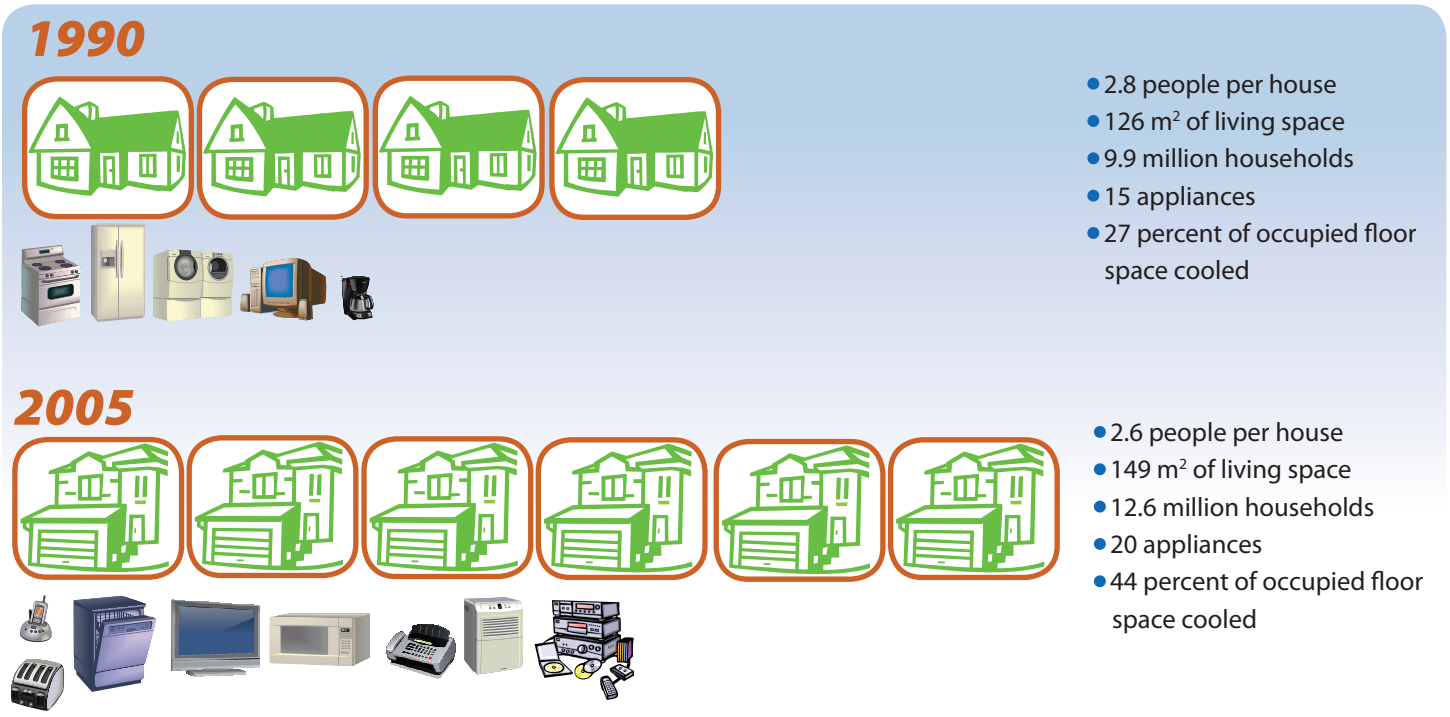
Canadians have bigger homes with fewer people living in them.

The choices Canadians made with respect to their living space also contributed to an increase in energy use. For example, homes built in 2005 were 149 square metres (m^2) on average. Homes built in 1990 had 126 m^2 of living space. Therefore, new homes are 19 percent bigger than homes built in 1990.

Canada has an aging population that tends to remain in their homes longer, in many cases long after their children have moved out. A falling birth rate and more young people living in single person households have contributed to a reduction in individuals per household from 2.8 in 1990 to 2.6 in 2005. This trend, coupled with population growth, has meant more dwellings built and therefore more energy consumed.

Canadians also used more devices that consume energy. For example, since 1990, Canadians use more minor appliances such as computers, televisions and microwaves, and choose to cool their homes during the summer months. These choices increased residential energy demand. The impact of these changes and the choices made by Canadians are further discussed in the following section, where each end-use is examined.

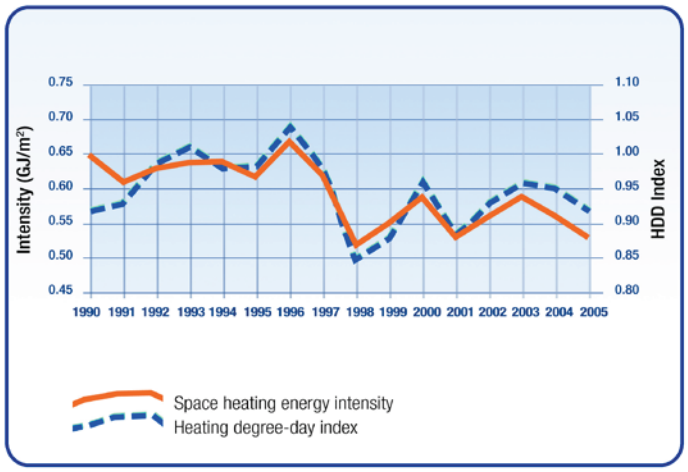
Figure 3.5 Residential energy indicators, 1990 and 2005



Trends – Residential space heating energy use and GHG emissions

Despite an 18 percent gain in space heating energy efficiency, total space heating energy use increased 8 percent between 1990 and 2005.

Figure 3.6 Space heating energy intensity and heating degree-day index, 1990-2005



The amount of energy used by the residential sector to heat each square metre of living space decreased 18 percent between 1990 and 2005. It decreased from 0.65 gigajoules per square metre (GJ/m^2) to 0.53 GJ/m^2. This decrease occurred mainly because more people chose natural gas over oil systems, and because natural gas furnaces became more efficient over this period.

Energy efficiency gains were realized because, to a large extent, less efficient systems were replaced with regulated medium and high efficiency systems. From 1990 to 2005, medium and high efficiency oil and gas systems increased their share of the oil and gas market from 6 percent to 48 percent.

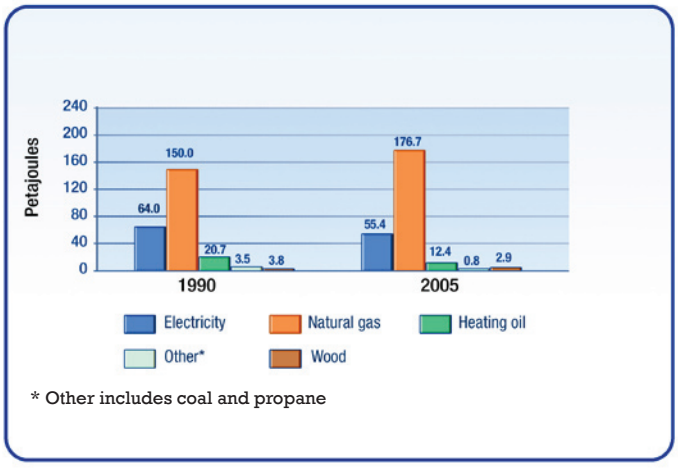
The amount of energy used to heat each square metre of living space in a Canadian home decreased. This was not enough to compensate for the fact that the number of households increased. Additionally, the average Canadian home was larger in 2005 than it was in 1990. Consequently, the energy required to heat all the dwellings in Canada increased from 782.7 PJ in 1990 to 846.1 PJ in 2005.

Trends – Residential water heating energy use and GHG emissions

Less energy is required per household for hot water due to increased use of natural gas and newer, more efficient water heaters.

Canadians shifted from using oil-fired water heaters to those that use natural gas and that are, on average, more energy efficient. In addition, current minimum energy performance standards mean that new water heaters use less energy than older models. As older stock is replaced by new stock, energy efficiency gains are realized. These changes resulted in an 18 percent decrease in the energy used per household for heating water (from 24.2 GJ per household to 19.7 GJ).

Figure 3.7 Water heating energy use by fuel type, 1990-2005



* Other includes coal and propane

Although there was a decrease in the energy used to heat water on a per household basis, a growing housing stock offset energy intensity improvements from new, more efficient equipment. The result was an overall increase of 4 percent in residential water heating energy use from 239 PJ to 248.2 PJ.

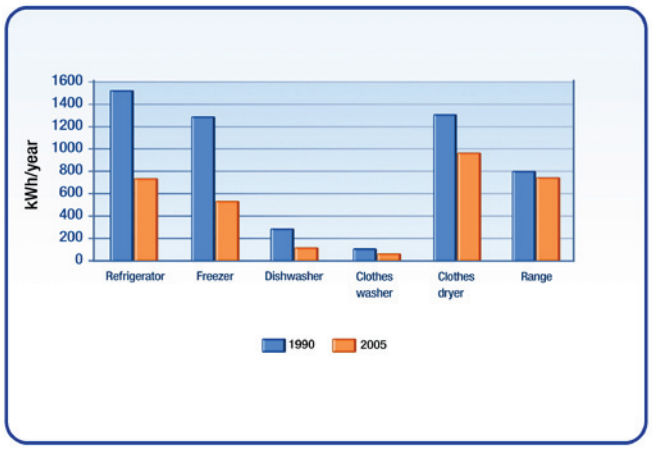
Trends – Residential appliance energy use and GHG emissions

The increased number of minor appliances offsets the benefits of the energy efficiency gains of major appliances.

The number of major appliances operated in Canada between 1990 and 2005 increased 38 percent. However, the total amount of energy that households used to power major appliances decreased 17 percent over the same period. In fact, the average unit energy use of all major household appliances decreased every year from 1990 to 2005.

The largest percentage decrease was in the unit energy use of dishwashers (see Figure 3.8), which in 2005 used 61 percent less energy than in 1990 (from 282 kilowatt hours [kWh] per year to 111 kWh per year).[3] A new fridge in 1990 used an average of 956 kWh per year versus 469 kWh per year in 2005, a decrease of 51 percent. These improvements in efficiency were due mainly to the introduction of minimum efficiency standards in the 1990s.

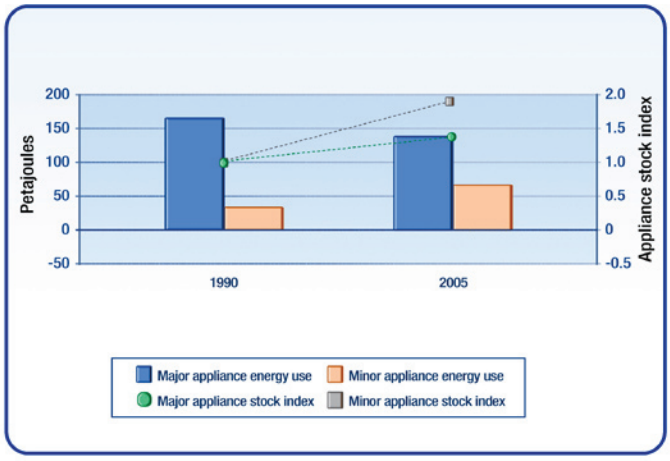
Figure 3.8 Unit energy consumption of major electric appliance stock, 1990 and 2005



In contrast to trends for major appliances, energy use for smaller appliances such as televisions, VCRs, DVDs, stereo systems and personal computers more than doubled (105 percent). This increase more than offset energy use reduction from major appliances. One example of the rapid growth in minor appliances is the increased penetration of personal computers. In 1990, computers were present in fewer than one of six households, but by 2005 were in more than five of seven households in Canada.

Energy demand for powering all household minor appliances more than doubled between 1990 and 2005. This increase of 33 PJ is equivalent to the energy required to provide lighting to almost half the homes in Canada in 2005.

Figure 3.9 Residential energy use and appliance stock index by appliance type, 1990 and 2005



Trends – Space cooling and GHG emissions

More Canadians live in air-conditioned homes during the summer months.

The amount of occupied floor space with space cooling more than doubled between 1990 and 2005. The percentage of floor space with space cooling went from 27 percent in 1990 to 44 percent in 2005. As a result, the energy required for cooling Canadian households rose from 11.6 PJ to 36.5 PJ over the period.

The increase in energy used for space cooling would have been more pronounced if not for efficiency improvements associated with room and central air conditioners. These cooled 33 percent and 16 percent of the space cooled stock, respectively.

[3] Excludes hot water requirements.

Figure 3.10 Space cooling stock and energy use, 1990-2005

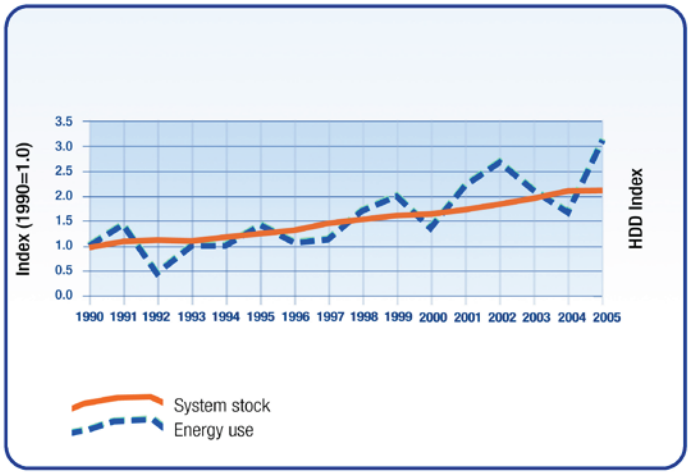
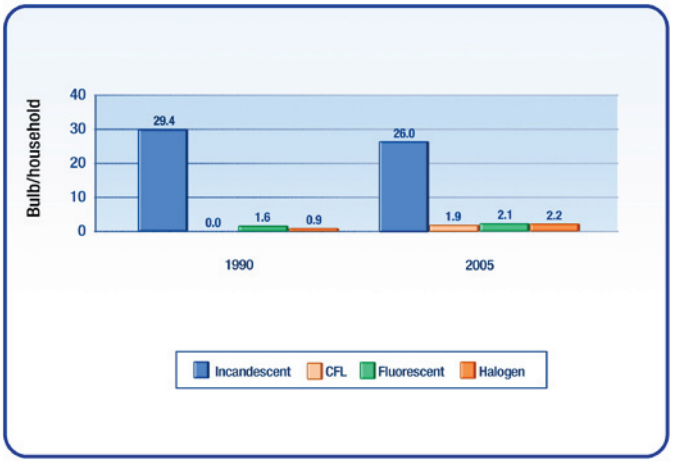


Figure 3.11 Number of light bulbs per household by bulb type, 1990 and 2005



Trends – Lighting energy use and GHG emissions

The market share of energy-efficient lighting alternatives increased between 1990 and 2005.

Despite a drop in lighting intensity, the energy required to light all households in Canada increased 23 percent, from 55.7 PJ to 68.4 PJ. This was due to the 27 percent increase in the number of households. The energy required to light each household in Canada decreased 3 percent, from 5.6 GJ to 5.4 GJ.

Some of the decrease in lighting intensity can be associated with the increased use of compact fluorescent lamps (CFLs), also known as compact fluorescent light bulbs, which use less energy to produce a certain level of light (Figure 3.11). CFLs represented 6 percent of light bulbs used in 2005[4] but were present in 32 percent of Canadian households in 2003.[5]

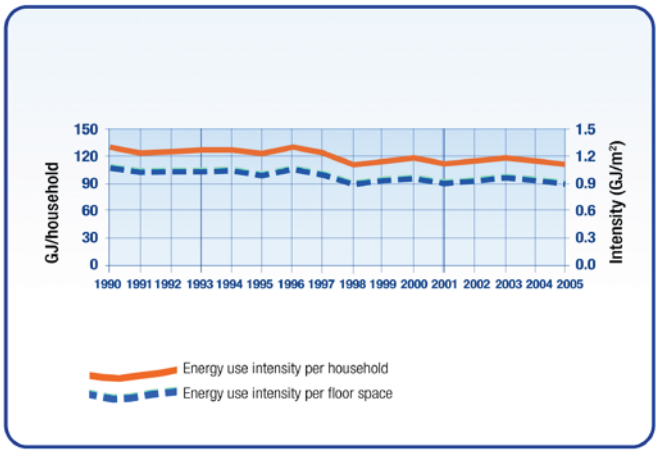
Residential energy intensity and efficiency

Energy intensity

The average household reduced its energy use by 14 percent.

In the residential sector, energy intensity is usually expressed as energy consumed per household. It can also be expressed as energy consumed per square metre of house area. Energy intensity decreased 14 percent, from 130.0 GJ per household in 1990 to 111.4 GJ in 2005. This occurred despite the average household operating more appliances, becoming larger, and increasing their use of space cooling. Energy intensity per square metre decreased 17 percent from 1.1 GJ to 0.9 GJ.

Figure 3.12 Residential energy intensity per household and floor space, 1990-2005



[4] Assumes CFLs entered the residential lighting market in 2000 and various bulb types are perfect substitutes. Trends are extrapolated from data collected from Natural Resource Canada, *Survey of Household Energy Use: 2003*, Ottawa, December 2005.

[5] Natural Resource Canada, *Survey of Household Energy Use: 2003*, Ottawa, December 2005.

Energy efficiency

Energy efficiency improvements resulted in an energy savings of $6.1 billion in the residential sector.

Energy efficiency improvements in the residential sector have resulted in significant savings between 1990 and 2005. These improvements include changes to the residential thermal envelope (insulation, windows, etc.) or changes to the efficiency of energy-consuming items in the home, such as furnaces, appliances and lighting.

Energy efficiency in the residential sector improved 25 percent from 1990 to 2005, allowing Canadians to save $6.1 billion in energy costs in 2005 and 320.9 PJ of energy.

These energy efficiency savings translate into an average savings of $488 per Canadian household in 2005.

Figure 3.13 Residential energy use, with and without energy efficiency improvements, 1990-2005

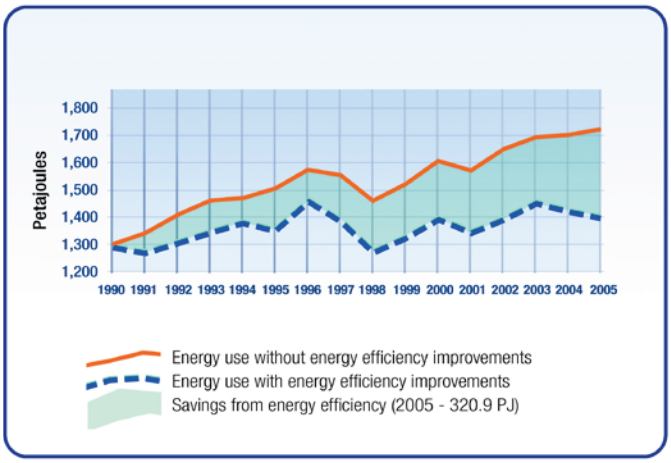


Figure 3.14 illustrates the influence that various factors had on the change in residential energy use between 1990 and 2005. These effects are the

- **activity effect** – As measured by combining a mix of households and floor space, energy use increased 30 percent (353 PJ). Growth in activity was driven by a 31 percent increase in floor area and by a rise of 27 percent in the number of households.
- **structure effect** – The increase in the relative share of households by dwelling type resulted in the sector using an additional 7.1 PJ of energy.
- **service-level effect** – The increased penetration rate of appliances and the increased floor space cooled by space cooling units were responsible for 71 PJ of the increase in energy.
- **weather effect** – In terms of degree days, the winter in 2005 was similar to the winter in 1990. However, the summer was warmer. The net result was that energy demand for temperature control in 2005 increased by 5.5 PJ compared to 1990.
- **energy efficiency effect** – Improvements to the thermal envelope of houses and to the efficiency of residential appliances and space and water heating equipment led to an overall energy efficiency gain in the residential sector. This saved 320.9 PJ of energy.

Figure 3.14 Impact of activity, structure, weather and energy efficiency on the change in residential energy use, 1990-2005