

**Guidance  
Document**

# HOME ENERGY CALCULATOR



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# Guidance Document for Manitoba Green Registry: Home Energy Calculator

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## Importance of this Calculator

Home Energy use – regardless of energy source – results in greenhouse gas (GHG) emissions. These emissions are created in one of two ways; either directly from burning fuels like oil or natural gas in your home, or indirectly from the generation of electricity you use. Coal and gas powered electricity generation have higher GHG emissions but even hydro-electric power in Manitoba results in some GHG emissions. The home energy calculator measures GHG emissions from the fuels and electricity used in your home for space heating, space cooling, water heating, home appliances, electronics, and lighting. It can be used for any type of household and home owners and renters can use the calculator to estimate their GHG emissions and use this to find options for reducing their GHG emissions or carbon footprint or for offsetting their GHG emissions.

The Home Energy Calculator can be used by home owners or renters for any type of residential dwelling to calculate the emissions resulting from all the energy uses in the home. Using the calculator involves entering information about your home energy use (from Manitoba Hydro billing information for electricity and natural gas) if available, and information about the location, size and type of dwelling. The calculator then measures your GHG emissions and provides links to appropriate actions for reducing GHG emission, along with information on incentive programs. Finally the calculator offers the option of purchasing GHG emissions offsets from Manitoba-based GHG emission reduction projects.

## Scope of Activity and Emissions

The Home Energy calculator estimates all of the GHG emissions associated with energy used in the home and the indirect GHG emissions associated with electricity generation. Home energy use emissions are attributable to the following end-uses:

- a) Space heating and cooling
- b) Water heating
- c) Operating appliances and electronic equipment
- d) Lighting

GHG emission for all energy sources are calculated for one full calendar year although this does not have to run from January through December. The calculator estimates emissions of the three main greenhouse gases emitted from home energy use, namely; carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O). In order to present a single metric for GHG emissions from home energy use the three GHGs are normalized to their carbon dioxide equivalence (CO<sub>2</sub>e) and the total GHG emissions are presented in CO<sub>2</sub>e. There are four design principles that were followed in the development of the calculator:

- The *Calculator* is NOT intended to be an energy audit or GHG emissions auditing tool. It is designed to generate a reasonable estimate of GHG emissions from home energy use in order to illustrate the size of your homes carbon footprint and the benefits of taking actions that reduce energy use in the home.
- The *Calculator* enables GHG emission comparisons between the user and the average resident of Manitoba with similar home characteristics and differences over time.
- The *Calculator* facilitates the comparison of different energy-using activities that contribute to total GHG emissions, such as heating, cooling water heating, and lighting.
- The *Calculator* has been designed to be user friendly and require minimal data inputs.

## Required User Inputs

The Home Energy calculator includes an online form with fields for users to input information about their home. This information allows the calculator to estimate the energy use and GHG emissions for the specific type of dwelling relative to the average per capita use in Manitoba. The fields requiring user input are:

**Input 1:** the size of the dwelling (in square feet or square metres)

**Input 2:** the type of dwelling (i.e., detached house, attached house, or apartment/condo)

**Input 3:** the dwelling's approximate year of construction

**Input 4:** the type of space heating (i.e., low, average, or high efficiency natural gas, or electric)

**Input 5:** the fuel source for water heating

**Input 6:** whether or not the dwelling has space cooling

**Input 7:** whether or not the dwelling owner or renter has access to the utility bills. If so, then:

**Input 8:** the total natural gas/electricity purchased in any 12 month period. This includes electricity consumption (in kWh) and, natural gas consumption (in M<sup>3</sup>)<sup>1</sup> if the user indicates natural gas heating, cooling, or appliances.

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<sup>1</sup> Manitoba Hydro utility bills are accessible at [http://www.hydro.mb.ca/mybill/mybill\\_welcome.shtml](http://www.hydro.mb.ca/mybill/mybill_welcome.shtml)

## Underlying Method and Data Sources

The most accurate way to estimate GHG emissions from home energy use is to calculate the amount of primary fuel (i.e. natural gas, heating oil, diesel, or wood) and electricity used over the course of a year multiplied by appropriate GHG emissions factor. Manitoba Hydro billing information includes the monthly consumption of natural gas (M<sup>3</sup>) and electricity (kWh). These can be added up to get the annual total and multiplied by fuel specific emission factors for Manitoba. These GHG emissions factors are taken from the National Greenhouse Gas Emission Inventory Report produced by Environment Canada each year.<sup>2</sup>

If the user does not have access to the Manitoba Hydro fuel and electricity billing information, then the calculator estimates these values based upon statistics representative of the building stock in Manitoba derived from data provided by the Office of Energy Efficiency (OEE) at Natural Resources Canada.<sup>3</sup> The data available from the OEE allows GHG emissions intensities (i.e., the GHG emissions from all fuels consumed for home energy purposes, per M<sup>3</sup>, per year) to be estimated according to all of the end-uses in the home that require energy. GHG emissions intensities are specific to the type of dwelling (including detached house, attached house, apartment/condo, and mobile home), the type of heating system used, the type of cooling system, appliances, and lighting.

For illustrative purposes, these variations in emission intensities are shown for the different types of residential dwellings in Manitoba built between 2001 and 2005. Both emissions from primary energy sources and emissions associated with purchased electricity are included in the emission intensities.

Space heating is the major energy user in a typical home (60% to 80%, depending on category and vintage), but with the requirements for space heating differing based upon the areal extent of building envelope that is exposed to outside elements. For example, a single attached home will require less energy and result in less emissions than a detached home when measured on a square metres basis since less of the building envelope is exposed to the outside elements (thus, it is more 'energy efficient'). It is assumed though that on an areal basis, there are no differences in the energy requirements for lighting, water heating or appliances in different home types.

Emission intensities also vary based upon the age of the home. This is illustrated for the average detached house in Manitoba (the most common type of dwelling). Again, both emissions from primary energy sources and emissions associated with purchased electricity are included in the emission intensities.

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<sup>2</sup> National Inventory Report 1990-2005: Greenhouse Gas Sources and Sinks in Canada - The Canadian Government's Submission to the UN Framework Convention on Climate Change, April 2007

<sup>3</sup> The Office of Energy Efficiency compile, on an annual basis, estimates of energy and emissions attributable to the residential sector for each province in Canada. This is done using a model of the Canadian residential sector that includes details of the building stock (number, size of dwellings, etc), data on fuel sources, heating systems, cooling systems, appliances contained in the home, etc. This modeling is calibrated to the Report on Energy Supply and Demand in Canada published by Statistics Canada to both maintain consistency with national energy demand and supply totals, as well as to improve the accuracy of the estimations produced. Please see [http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive\\_tables/index.cfm?attr=0](http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0)

Figure 1. Emission intensity by dwelling type constructed between 2001 and 2005, in kg CO<sub>2</sub>e/m<sup>2</sup>/year

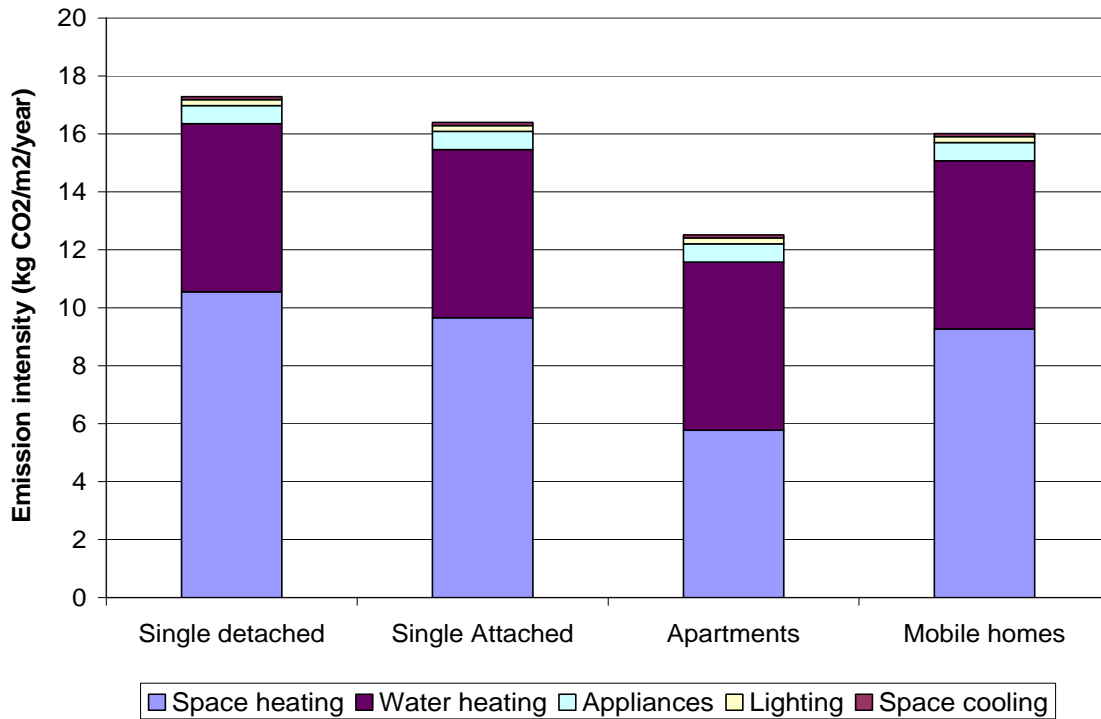


Figure 2. Emission intensities for the average Manitoban detached house, by end-use and vintage

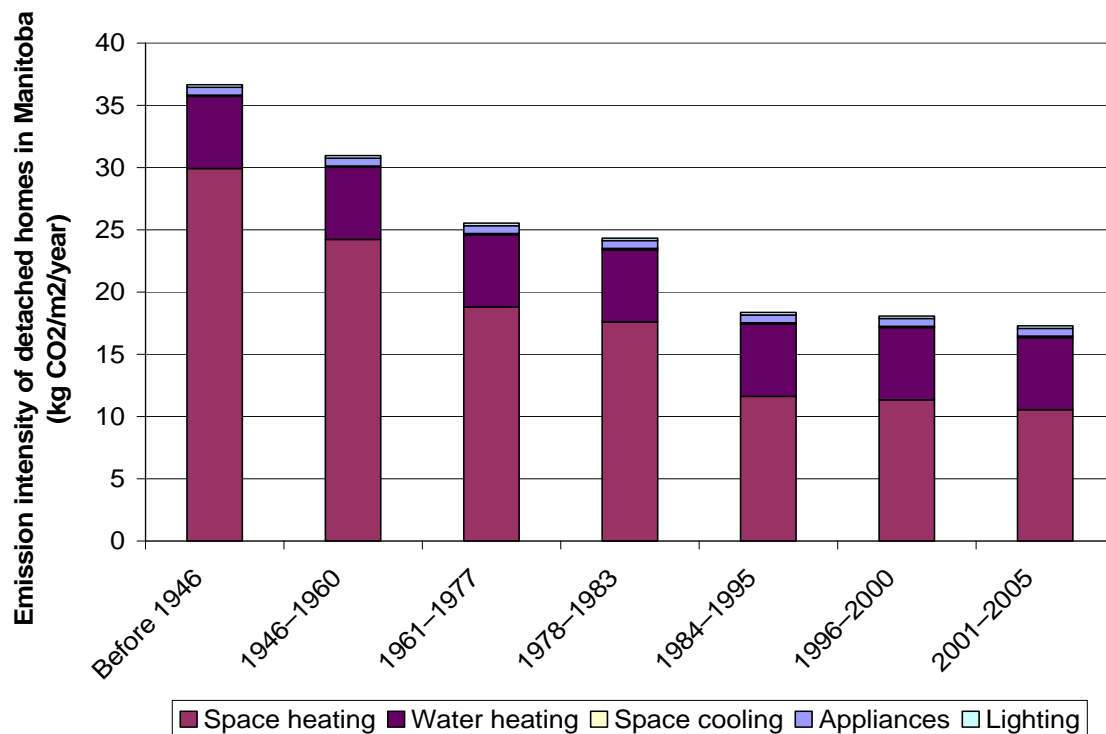


Figure Two illustrates that GHG emissions attributable to space heating, on a percentage of total emissions, increase from approximately 62% for homes built between 2001 and 2005, to approximately 81% for homes built before 1946. This increase reflects both the lower technical efficiency of the home heating systems in older buildings and the lower thermal efficiency of the building envelopes.

The second point concerns the relative importance of space heating and water heating to total GHG emissions. It is important to note that the larger contribution of these two end uses not only reflects the energy requirements, but also the fact that appliances (except gas stoves), most space cooling, and all lighting are electric. Since most electricity in Manitoba is generated from hydro-electric sources, these end-uses result in lower GHG emissions when compared to activities such as home heating from natural gas or oil. In jurisdictions with more gas or coal fired electricity generation, the difference would be less pronounced.

Considering the importance of home heating related GHG emissions, it is important to make precise estimates by using different GHG emissions intensities for different heating systems. This is especially relevant to the calculation if annual totals for fuel consumption are not known. GHG emissions are estimated based upon the size and age of the dwelling, but also the fuel source used to provide space heating and the efficiency of the heating system.

To help understand how GHG emissions vary based upon the type of heating system used in the home, the OEE provides energy and GHG emissions by home heating system along with information on the stocks of the heating systems in service.<sup>4</sup> This allows GHG emissions intensities to be produced on unit basis (see figure 3). We assume that variations in GHG emissions intensity on a unit basis are representative of variations in GHG emissions intensity on an area basis.

As shown in the figure, GHG emissions intensities vary from approximately 18.25 kg CO<sub>2</sub>e/m<sup>2</sup>/year for heating systems fuelled by propane, heating oil, or coal (i.e. the ‘Other’ category), to less than 0.5 g CO<sub>2</sub>e/m<sup>2</sup>/year for homes fuelled only by wood.<sup>5</sup>

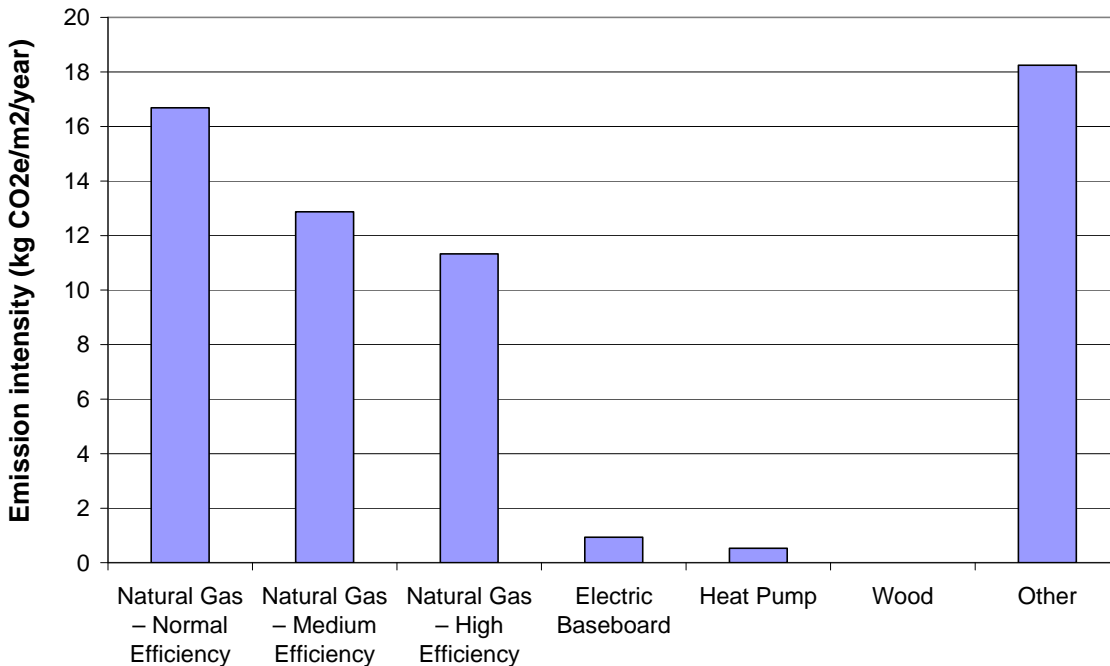
<sup>4</sup> The specific energy efficiencies of the different home heating systems are shown below:

Heating Oil – Normal Efficiency	60%	Natural Gas – Normal Efficiency	62%
Heating Oil – Medium Efficiency	78%	Natural Gas – Medium Efficiency	80%
Heating Oil – High Efficiency	85%	Natural Gas – High Efficiency	90%
Electric Baseboards	100%	Wood	50%
Heat Pump	190%	Other (propane, coal)	50%

<sup>5</sup> The emission factor for the combustion of wood only includes CH<sub>4</sub> and N<sub>2</sub>O released during biomass combustion, and does not include the CO<sub>2</sub> attributable to the loss of wood from the forest. This is the same approach as used in the National Inventory of Greenhouse Gas Emissions, where these emissions are included only in the ‘Land Use, land Use Change, and Forestry’ sector. These emissions are currently not counted towards Canada’s national inventory totals as considered for the purposes of the Kyoto Protocol.

GHG emissions intensities were then developed by dwelling type, type of heating system, fuel sources, and vintage of dwelling using the proportional differences between the heating systems presented in figure 3.

**Figure 3. Emission intensities for different home heating systems in detached homes in Manitoba (kg CO<sub>2</sub>e/m<sup>2</sup>/year)**



## Using the Calculator

The Home Energy Calculator is an important tool for measuring your carbon footprint. The Manitoba climate and standard of living requires and allows for significant energy use in the home for heat in winter, cooling in summer and powering our lights and appliances all year round. Understanding the GHG emissions arising from the way we run our households is a valuable step in addressing climate change in Manitoba. Home energy use makes a large contribution to our carbon footprint but is also an area where small changes can lead to big improvements.

The Home Energy Calculator can produce a meaningful estimate of energy use based on the size and type of home even without precise data on energy use. This baseline measurement is the starting point for planning how to reduce GHG emissions. The calculator links the user to incentive programs and recommended actions for reducing home energy use. Users can select the options that are appealing to them and see the results reflected in a lower carbon footprint over time. Energy efficiency in the home is an important aspect of Manitoba’s climate change strategy and a way for home owners to reduce their carbon footprint while saving money.