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Energy Efficiency Trends in Canada 1990 to 2010

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Preface

This 16th edition of *Energy Efficiency Trends in Canada* delivers on Canada's commitment to provide a comprehensive summary of secondary energy use and related greenhouse gas (GHG) emissions in Canada. It also tracks trends in energy efficiency. This year's edition is produced electronically and in paper format.

For more secondary energy use statistics, see the comprehensive energy use database. The database includes most of the historical energy use and GHG emissions data used by Natural Resources Canada's (NRCan's) Office of Energy Efficiency (OEE). This database can be viewed at oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/databases.cfm?attr=0.

This report covers the four sectors analysed by the OEE, which are the residential, commercial/institutional, industrial and transportation sectors. The 2010 period is the most recent year for which data are available.

The reader should be aware that this edition of the *Energy Efficiency Trends in Canada* is based on the revised *Report on Energy Supply and Demand* (RESD), 1995–2010, which represents a re-setting of the energy balances for Canada. The RESD data were released September 14, 2012, on CANSIM and include revisions for all sectors because of the incorporation of the full Industrial Consumption of Energy (ICE) survey and the Survey of Secondary Distributors of Refined Petroleum Products. Previously, the industrial estimates were based on a representative sample of enterprises in the ICE survey by sector. The revised RESD now incorporates all enterprises in the survey to present a more complete and accurate view. The revised RESD data also incorporate results from the Survey of Secondary Distributors of Refined Petroleum Products. This change caused a re-allocation of energy use to end-users of refined petroleum products and away from the commercial sector.

This report reflects these revisions over time, and every effort has been made to preserve historical trends. However, use caution when comparing this data set and analysis to the previous versions because the level of energy use may have changed, and growth rates may have been revised.

For more information about this product or the services that the OEE offers, contact us by e-mail at euc.cec@nrcan-rncan.gc.ca.

This report was prepared by Naïma Behidj, Monique Brugger, Rosita Kwan, Stéphane Leblanc, Yantao Liu, Michael Warbanski and Fumiko Yamada, who are staff of the Demand Policy and Analysis Division of the OEE. John Appleby was responsible for the report, with Laura Oleson providing overall direction

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Chapter 1

1 Introduction

Canadians spent $163 billion on energy in 2010.

Energy accounts for a large segment of spending by households, businesses and industries alike. In 2010, Canadians spent about $163 billion on energy to heat and cool their homes and offices and to operate their appliances, cars and industrial processes. This amount is equivalent to almost 11 percent of the country's gross domestic product (GDP).

This report provides an overview of Canada's secondary energy use and related GHG emissions. In addition to providing detailed information about energy intensity and energy efficiency levels in 2010, this report also analyses the energy intensity and efficiency trends between 1990 and 2010. Such monitoring aids the OEE in promoting energy efficiency in all aspects of Canadian life. It contributes toward the goal of making Canada a world leader in environmental responsibility in the development and use of natural resources.

Measurement of energy

To compare sources of energy, all energy consumption data presented in this report are expressed in joules. One joule is equivalent to the work required to produce one watt of power continuously for one second. One petajoule (PJ), or 10^{15} joules, is equivalent to the energy required by more than 9,000 households (excluding transportation requirements) over one year.

Two types of energy use

There are two general types of energy use: primary and secondary. Primary energy use (Figure 1.1) encompasses the total requirements for all users of energy. This includes secondary energy use. Additionally, primary energy use refers to the energy required to transform one form of energy to another (e.g. coal to electricity).

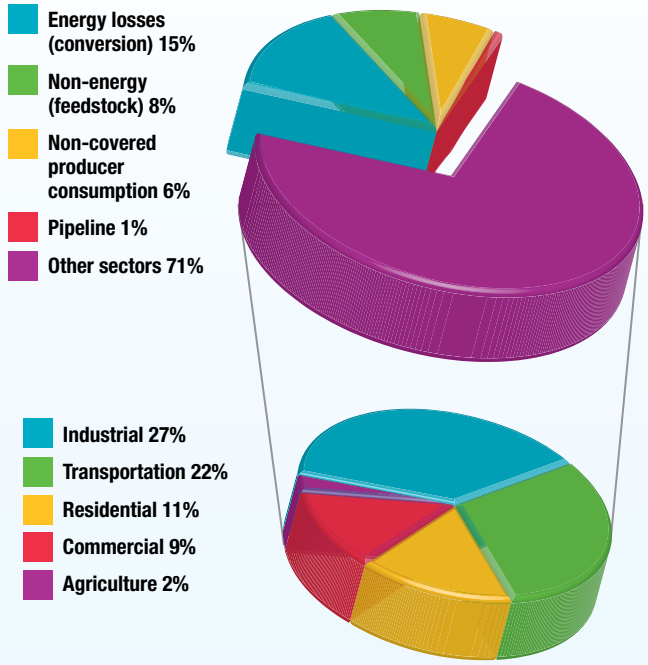
It also includes the energy used to bring energy supplies to the consumer (e.g. pipeline). Further, it entails the energy used to feed industrial production processes (e.g. the natural gas used as feedstock by the chemical industries). In 2010, the total amount of primary energy consumed was estimated at 11,959.6 PJ (see Appendix A, "Reconciliation of data," for more details).

Secondary energy use[1] (Figure 1.1) is the energy used by final consumers in various sectors of the economy. This includes, for example, the energy used by vehicles in the transportation sector. Secondary energy use also encompasses energy required to heat and cool homes or businesses in the residential and commercial/institutional sectors. In addition, it comprises energy required to run machinery in the industrial and agricultural sectors. Secondary energy use accounted for almost 71 percent of the primary energy use in 2010, or 8,479.1 PJ.

This report focuses on secondary energy use and assesses trends in this category. The energy used to generate electricity is also included to allow the link of electricity emissions to the appropriate final users of electricity. This mapping of GHG emissions to appropriate electricity consumers is discussed in more detail in the section GHG emissions.

[1] Secondary energy use covered in this report excludes pipeline energy use, producer consumption, non-energy use (feedstock) and energy losses (conversions).

Figure 1.1 – Primary and secondary energy use by sector, 2010



All subsequent references to "energy" in this report refer to secondary energy.

GHG emissions

This report also analyses energy-related GHG emissions, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). CO_2 represents almost 98 percent of Canada's energy-related GHG emissions.

Total Canadian GHG emissions are estimated to have been 692 megatonnes (Mt) in 2010; 70 percent of this total (or 484.4 Mt) resulted from secondary energy use (including electricity-related GHG emissions).[2]

Unlike other end-use energy sources, electricity use does not produce any GHG emissions at the point of consumption. GHG emissions related to electricity are emitted at the point of generation. These are sometimes referred to as indirect emissions.

Therefore, it is a common practice in energy end-use analysis to allocate GHG emissions associated with electricity production to the sector that uses that electricity. This allocation is done by multiplying the amount of electricity used by a national average emission factor that reflects the average mix of fuels used to generate electricity in Canada.

Environment Canada's *National Inventory Report, 1990–2010 – Greenhouse Gas Sources and Sinks in Canada* has more information about total Canadian GHG emissions. This GHG inventory was prepared according to the specifications of the Intergovernmental Panel on Climate Change, accounting for all types of GHG emissions in Canada. However, NRCan's OEE developed a sectoral mapping that is more suited to energy end-use analysis.

All subsequent references in this report to GHG emissions are expressed in tonnes of carbon dioxide equivalent (CO_2e). They include only emissions directly attributable to secondary energy use and indirect emissions attributable to electricity used as final demand, unless otherwise specified.

[2] These figures are OEE estimates; Environment Canada is responsible for Canada's official GHG inventory.

1 Introduction

Energy intensity and energy efficiency

The term energy intensity is used frequently throughout this report. Energy intensity is the ratio of energy use per unit of activity. Because energy intensity is a simple calculation for which data are readily available, it is often used as a proxy for energy efficiency. However, this practice can be misleading: in addition to pure energy efficiency, energy intensity captures the impact of many factors that influence energy demand, such as weather or structural change.

Because of this inherent short-coming in the energy intensity measure, the OEE tracks energy efficiency in a way that gauges changes in energy demand due to changes in activity, economic structure, service level and weather. In summary, the energy efficiency measure factors out these items from the energy intensity calculation.

The methodology of this factorization – the Log-Mean Divisia Index I (LMDI I) methodology – is an internationally recognized factorization analysis technique. It decomposes changes in energy use into the various drivers in each sector so that energy efficiency can be assessed.[3]

In this report

This report describes secondary energy use in Canada, overall and also at a sectoral level. For each sector, the status in 2010 of energy use and GHG emissions is described, followed by the trends in energy use and GHG emissions from 1990 to 2010. Finally, the overall and sector analysis provides the results of the factorization analysis and a detailed discussion of the trends in energy efficiency and energy intensity over the sample period.

[3] Contact us at euc.cec@nrcan-rncan.gc.ca to obtain further information regarding the LMDI I methodology from the report prepared by M. K. Jaccard and Associates for OEE, *Improvement of the OEE/DPAD Decomposition Methodology*, 2005.