IEA-Advanced Motor Fuels
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CANADA

Canada

Introduction

Canada is a vast northern nation with a relatively small population, a developed economy, and a large natural resource base. Combined, these factors have helped to shape Canada's energy production and consumption patterns. Climate and geography play a key role in Canada's relatively high energy intensity. A cold and variable northern climate means more energy is consumed heating homes and businesses. Similarly, goods and people often travel farther to reach their destinations due to Canada's large land mass. This requires more energy use compared to geographically smaller nations.[1]

There are more than 1.3 million lane-kilometers (two-lane equivalent) of public road in Canada. Approximately 34% of the road network is paved, while 66% is unpaved. In 2013, the National Highway System included more than 38,000 lane-kilometers. In 2013, more than 23 million road motor vehicles were registered in Canada, up 2.9% from 2012. A majority (92.4%) were vehicles weighing less than 4,500 kilograms (kg) (mainly passenger automobiles, pickups, sport utility vehicles, and minivans), while 4.3% were medium- and heavy-duty trucks weighing 4,500 kg or more, and 3.3% were other vehicles such as buses, motorcycles, and mopeds.[2]

In 2014, oil sands production was 2.2 million barrels/day compared to 1.6 million barrels/day of conventional oil. Canada has the third largest oil reserve in the world behind Venezuela and Saudi Arabia. Oil sands represent 97% of Canada's proven reserves.[3]

Canada produced an average of 14.7 billion cubic feet/day of marketable natural gas in 2014.[4] Remaining marketable Canadian natural gas resources as of December 2014 were 1,087 trillion cubic feet.[5]

Table 1 shows the Canadian supply of and demand for ethanol and biodiesel in 2014.

Table 1 Canadian Supply of and Demand for Biofuels (in millions of liters)[6]

1 https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016/index-eng.html.

2 https://www.tc.gc.ca/media/documents/policy/2014_TC_Annual_Report_Overview-EN.pdf.

3 http://www.nrcan.gc.ca/publications/key-facts/16013.

4 https://www.neb-one.gc.ca/nrg/sttstc/ntrlgs/rprt/ntrlgsdlvrblty20152017/ntrlgsdlvrblty20152017-eng.html.

5 http://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016/index-eng.html.

Parameter	Ethanol (2014)	Biodiesel (2014)
Canadian production	1,731	Not available
Imports	1,138	506
Exports	Not available	123
Domestic use	2,869	Not available

Policies and Legislation

Renewable Fuels Regulations

The *Renewable Fuels Regulations* (SOR/2010-189), published on September 1, 2010, in the *Canada Gazette*, Part II, require fuel producers and importers to have an average renewable content of at least 5% based on the volume of gasoline that they produce or import commencing December 15, 2010. These regulations include provisions that govern the creation of compliance units, allow trading of these units among participants, and also require recordkeeping and reporting to ensure compliance.

The regulations also require fuel producers and importers of diesel fuel and heating distillate oil to have an average annual renewable fuel content equal to at least 2% of the volume of diesel fuel and heating distillate oil that they produce and import commencing July 1, 2011. The *2013 Regulations Amending the Renewable Fuels Regulations (SOR/2013-187)* introduced a national exclusion of heating distillate oil volumes for space heating purposes as of January 1, 2013.[7]

Table 2 provides an overview of federal and provincial biofuels regulations.

6 http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/files/pdf/EnergyFactBook2015-Eng_Web.pdf.

7 http://www.ec.gc.ca/energie-energy/default.asp?lang=En&n=0AA71ED2-1.

Table 2 Federal and Provincial Regulations on Biofuels[8]

Location	Percentage of Renewable Fuels Content	
	Gasoline	Diesel
Canada	5	2
British Columbia	5	4
Alberta	5	2
Saskatchewan	7.5	2
Manitoba	8.5	2
Ontario	5	2
Quebec	5 (target only)	0

Renewable-Fuels-Related Standards

The Canadian General Standards Board (CGSB) is the responsible authority for developing fuel quality standards, including standards for renewable fuel quality through a consensus process with the public and private sectors. Table 3 shows the biofuel-related standards for transportation.[9]

Table 3 CGSB Renewable Fuel Quality Related Standards[9]

Fuel Standard	Number
Oxygenated Automotive Gasoline Containing Ethanol (E1–E10)	CAN/CGSB 3.511
Automotive Ethanol Fuel (E50–E85)	CAN/CGSB 3.512
Denatured Fuel Ethanol for Use in Automotive Spark Ignition Fuels	CAN/CGSB 3.516
Automotive Diesel Fuel Containing Low Levels of Biodiesel (B1–B5)	CAN/CGSB 3.520
Diesel Fuel Containing Biodiesel (B6–B20)	CAN/CGSB 3.522
Biodiesel (B100) for Blending in Middle Distillate Fuels	CAN/CGSB 3.524

Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations

In October 2010, the Government of Canada released the final *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*, which prescribe progressively more stringent annual emission standards for new vehicles of model years 2011 to 2016. The Government also published regulations in 2014 for the second phase of action on light-duty vehicles (LDVs), which contain increasingly stringent greenhouse gas (GHG) emissions standards for LDVs of model years 2017 to 2025.

8 http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/files/pdf/EnergyFactBook2015-Eng_Web.pdf.

9 http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html.

Under both phases of LDV regulations, spanning model years 2011 to 2025, the fuel efficiency of new cars will increase by 41% as compared with model year 2010 (and 50% compared with the 2008 model year), and the fuel efficiency of new passenger light trucks will increase by 37%. The sales-weighted fuel efficiency of new cars is projected to improve from 8.6 liters per kilometer (L/100 km) in 2010 to 6.4 L/100 km in 2020 and to 5.1 L/100 km by 2025. The sales-weighted fuel efficiency of new passenger light trucks is projected to improve from 12.0 L/100 km in 2010 to 9.1 L/100 km in 2020 and to 7.6 L/100 km by 2025.[10]

Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations

The objective of the *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* is to reduce GHG emissions by establishing mandatory GHG emission standards for new on-road heavy-duty vehicles and engines that are aligned with U.S. national standards. The development of common North American standards will provide a level playing field that will lead North American manufacturers to produce more advanced vehicles, which enhances their competitiveness. The regulations will apply to companies manufacturing and importing new on-road heavy-duty vehicles and engines of the 2014 and later model years for the purpose of sale in Canada. These include the whole range of on-road heavy-duty full-size pickup trucks, vans, tractors, and buses, as well as a wide variety of vocational vehicles such as freight, delivery, service, cement, and dump trucks. The regulations will also include provisions that establish compliance flexibilities, which include a system for generating, banking, and trading emission credits. The regulations will include additional credits for hybrid vehicles and electric vehicles, as well as for innovative technologies to reduce GHG emissions. The regulations will include further flexibilities for companies to use a phased-in approach for model year 2014 through 2016 tractors and vocational vehicles. Companies will also be required to submit annual reports and maintain records relating to the GHG emission performance of their vehicles and fleets.[11] The regulations for heavy-duty vehicles will improve the average fuel efficiency of trucks from 2.3 L/100 tonne-km in 2012 to 2.2 L/100 tonne-km by 2020.[12]

Sulphur in Gasoline Regulations

10 https://ec.gc.ca/ges-ghg/default.asp?lang=En&n=E0533893-1.

11 http://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=214.

12 https://ec.gc.ca/ges-ghg/default.asp?lang=En&n=E0533893-1.

The *Sulphur in Gasoline Regulations*, published on June 23, 1999, limit sulphur in gasoline to an annual average level of 30 milligrams per kilogram (mg/kg), or 30 parts per million (ppm), with a never-to-be-exceeded limit of 80 mg/kg, beginning in 2005. The regulations also include a simpler default option of a 40-mg/kg per batch limit, with minimal administrative requirements. These regulations have reduced the sulphur content of gasoline by more than 90% from 1999 levels. On July 29, 2015, the *Regulations Amending the Sulphur in Gasoline Regulations* were published. These amendments limit the allowable sulphur content of gasoline to an annual average level of 10 mg/kg, with a never-to-be-exceeded limit of 80 mg/kg, beginning in 2017. The default per batch limit remains at the current sulphur level of 40 mg/kg until the end of 2016, and will be reduced to 14 mg/kg during the 2017–2019 period. For 2020 and beyond, the default per batch limit will be 12 mg/kg.[13]

Implementation: Use of Advanced Motor Fuels

The Government of Canada has committed to developing increasingly stringent GHG emissions regulations for passenger cars and trucks, in alignment with the United States. In order to meet these standards, manufacturers will introduce a wide range of technology innovations to improve vehicle efficiency over the next several years.

ecoTECHNOLOGY for Vehicles Program

Transport Canada's ecoTECHNOLOGY for Vehicles Program (eTV) conducts in-depth safety, environmental, and performance testing on a range of new and emerging advanced vehicle technologies for passenger cars and heavy-duty trucks. The eTV Program will help ensure that Canada is ready for new and emerging advanced vehicle technologies, and that Canadians can benefit from these new innovations. To achieve this, eTV is proactively testing and evaluating a range of new advanced vehicle technologies. Results are helping to inform the development of environmental and safety regulations to ensure that these technologies are introduced in Canada in a safe and timely manner. The eTV Program also supports the Canada–U.S. Regulatory Cooperation Council. Test results will help align vehicle regulations throughout North America, in order to reduce and prevent barriers to cross-border trade, lower costs for businesses and consumers, and support jobs and growth.[14]

Program of Energy Research and Development

13 https://www.ec.gc.ca/energie-energy/default.asp?lang=En&n=BEA13229-1.

14 https://www.tc.gc.ca/eng/programs/environment-etv-menu-eng-118.htm.

The Program of Energy Research and Development (PERD) is a federal, interdepartmental program operated by Natural Resources Canada. PERD funds research and development (R&D) designed to ensure a sustainable energy future for Canada in the best interests of both the economy and environment. It directly supports energy R&D conducted in Canada by the federal government and is concerned with all aspects of energy supply and use. Part of PERD consists of coordinated research activities designed to extend key areas of knowledge and technology that will help reduce both the carbon footprint of fuels and vehicle emissions from transportation sources in Canada.[15]

Outlook

As depicted in Table 4, the transportation sector comprises several distinct subsectors: passenger, freight, air, and others (e.g., rail and marine). Each subsector exhibits different trends during the projected period. For example, emissions from passenger transportation are projected to decrease by 8 megatonnes (Mt) between 2005 and 2020, while those for ground freight, off-road, and other vehicles are projected to grow by 10 Mt over the same time period due to anticipated economic growth. As a result, net emissions remain essentially stable over the period. Although absolute emissions are expected to grow in the freight subsector due to expected economic growth, emissions are expected to decrease relative to business-as-usual levels as a result of various federal, provincial, and territorial programs.[16]

Table 4 Transportation: Emissions (Mt CO_2 equivalent)[16]

Transportation Subsector	2005	2012	2020	Change (2005 to 2020)
Passenger Transport	96	94	88	−8
Cars, trucks, and motorcycles	87	85	78	−9
Bus, rail, and domestic aviation	9	8	9	0
Freight Transport	57	61	67	10
Heavy-duty trucks, rail	49	54	59	10
Domestic aviation and marine	8	7	8	0
Other: Recreational, commercial, and residential	14	11	12	−2
Total	168	165	167	−1

15 http://www.nrcan.gc.ca/energy/science/programs-funding/1603.

16 https://ec.gc.ca/ges-ghg/default.asp?lang=En&n=E0533893-1.

Passenger energy demand declines over the projection period, largely due to increasing fuel economy associated with Canada's *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*. Since passenger travel uses the majority of gasoline in the transportation sector, this leads to a decrease in the fuel share of gasoline demand, as shown in Figure 1.[17]

Freight demand is driven by growth in the goods-producing industries and increases at a slower rate than it did from 1990 to 2013. This is from fuel economy gains, associated with Canada's *Heavy Duty Vehicle and Engine Greenhouse Gas Emission Regulations*, and somewhat slower economic growth over the projection period. The increase in freight share leads to an increase in the fuel share of diesel.[17]

Natural gas use in the transportation sector is another emerging trend. Natural gas vehicles (NGVs) use either compressed natural gas (CNG) or liquefied natural gas (LNG). In the longer term, the projections include a moderate penetration of NGVs in both forms. The outlook also accounts for the recent adoption of LNG use by ferries, and assumes moderate levels of LNG adoption by marine tankers and rail locomotives. In the reference case, freight natural gas use reaches 151 petajoules (PJ) in 2040, representing 10% of total freight demand.[17]

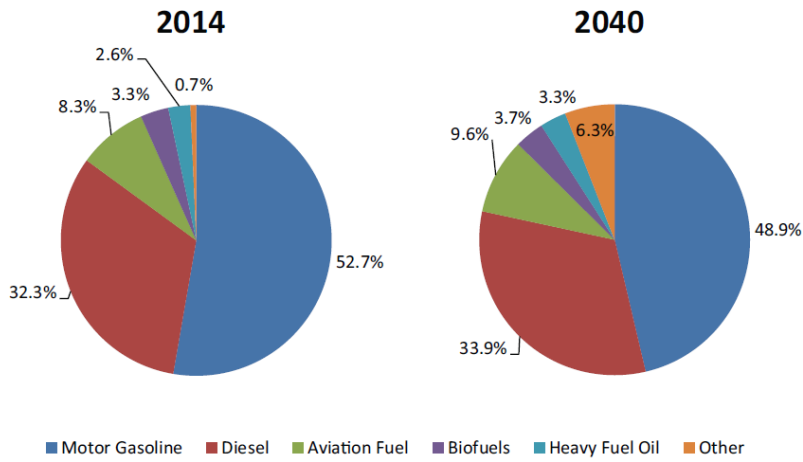

Fig. 1 Transportation Energy Fuel Share of Demand, Reference Case (Other includes natural gas, electricity, lubricants, and propane)[17]

Additional References

17 http://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016/index-eng.html.

- National Research Council Canada, Automotive and Surface Transportation, http://www.nrc-cnrc.gc.ca/eng/rd/ast/
- National Research Council Canada, Industrial Research Assistance Program, http://www.nrc-cnrc.gc.ca/eng/irap/index.html
- Natural Resources Canada, the ecoENERGY Innovation Initiative, http://www.nrcan.gc.ca/energy/funding/current-funding-programs/eii/4985
- Natural Sciences and Engineering Research Council of Canada, http://www.nserc-crsng.gc.ca/index_eng.asp
- Sustainable Development Canada, SD Natural Gas Fund, https://www.sdtc.ca/en/apply/sd-natural-gas-fund