Chapter 2

Energy Use in Ontario

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Abstract

This chapter provides a macro-level analysis of Ontario's energy use in 2015 in light of key factors. These factors include population and economic changes, as well as conservation programs.

Despite population and economic growth, Ontario's overall energy use did not change significantly between 2014 and 2015; in other words, Ontario continues to improve its energy efficiency. However, further improvements in energy efficiency are not only possible but necessary if the province is to meet its greenhouse gas reduction targets. Significant fuel switching to cleaner, non-carbon based fuels will also be needed.

This chapter also provides a more detailed analysis of fuel-by-fuel use changes in Ontario from 2014 to 2015. Transportation fuel use increased slightly (likely influenced by lower gas prices), while natural gas use decreased slightly (partly due to a warmer winter). Though electricity use has remained almost the same, the supply mix has changed, with more generation from natural gas and renewable energy.

2.1 Overall Energy Use Changes

Ontario's energy mix is made up of three main fuel types: transportation fuels[i] (39%), natural gas (37%), and electricity (20%). The remaining small share of the province's energy use consists of propane (2%), oil (1%) and other fuels[ii] (1%). The majority of Ontario's energy use is fossil-fuelled (see Figure 2.1).

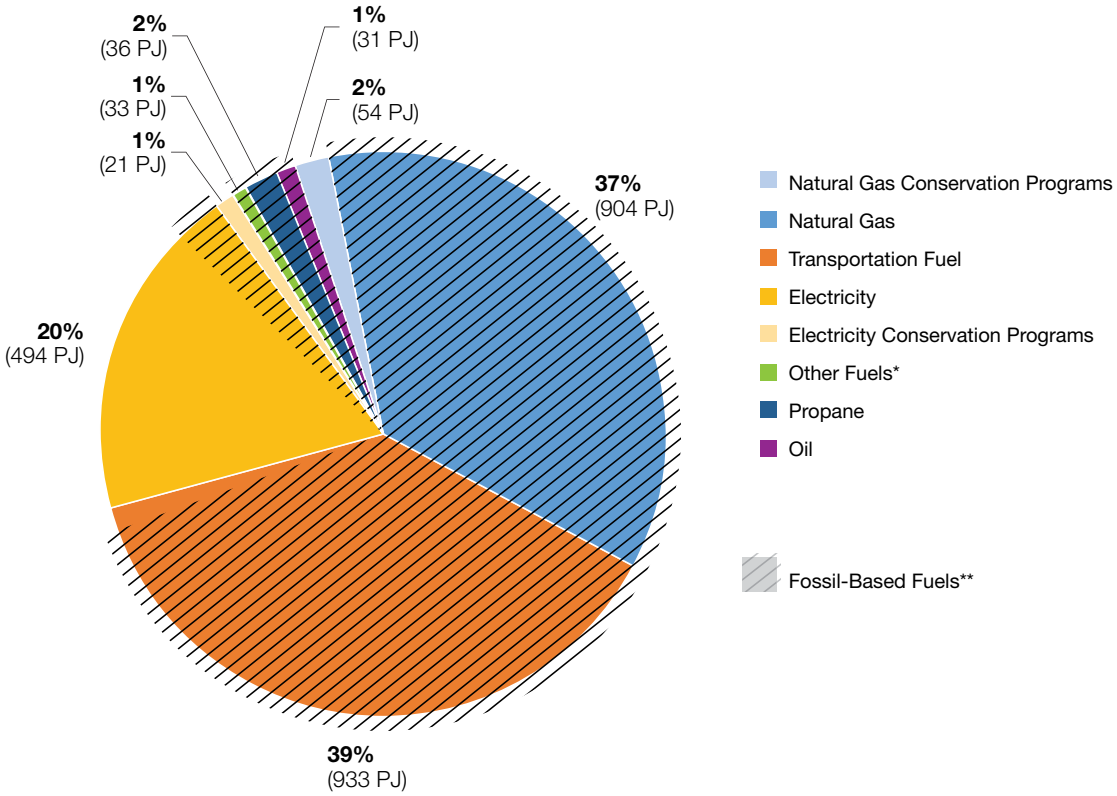

Figure 2.1. Share of overall energy use in Ontario, by fuel type, including demand reduced by utility-run conservation programs - fossil-based fuel sources also highlighted (2015).

Note: 2015 data is preliminary, meaning it is likely to be revised (typically about 1-2%) within a year by Statistics Canada. The percentages total 103 in order to include the 3% demand reduction due to electricity and natural conservation programs. Conservation savings are the sum of annual savings from 2006 through 2015.

***"Other Fuels"** includes coal, crude oil, steam, petroleum coke, coke and coke oven gas. No data is available for coke or coke oven gas use, which can represent up to 120 PJ.

****Non **"Fossil-Based Fuels"** include about 3.6% of transportation fuels that are bio-based (ECO estimate), and the 90% of electricity produced by nuclear, wind, solar, and biofuels. The percentage of natural gas made from biofuels is not shown as it is negligible.

Source: Statistics Canada, CANSIM table 128-0016; Enbridge and Union Gas' draft 2015 DSM reports, tables 3-9; IESO.

Ontario's energy use has remained relatively consistent from 2007 to 2015 due to energy efficiency improvements.[1] Energy use did not increase despite 8% population growth and 17% economic growth (as measured by real gross domestic product) (see Figure 2.2).[2] Thus, energy use per person has decreased by 7% and per dollar of gross domestic product has decreased by 15%.

[i] "Transportation fuels" include: motor gasoline, diesel fuel oil, heavy fuel oil, aviation gasoline, and aviation turbo fuel.
[ii] "Other fuels" include: coal, crude oil, petroleum coke, steam, coke and coke oven gas.

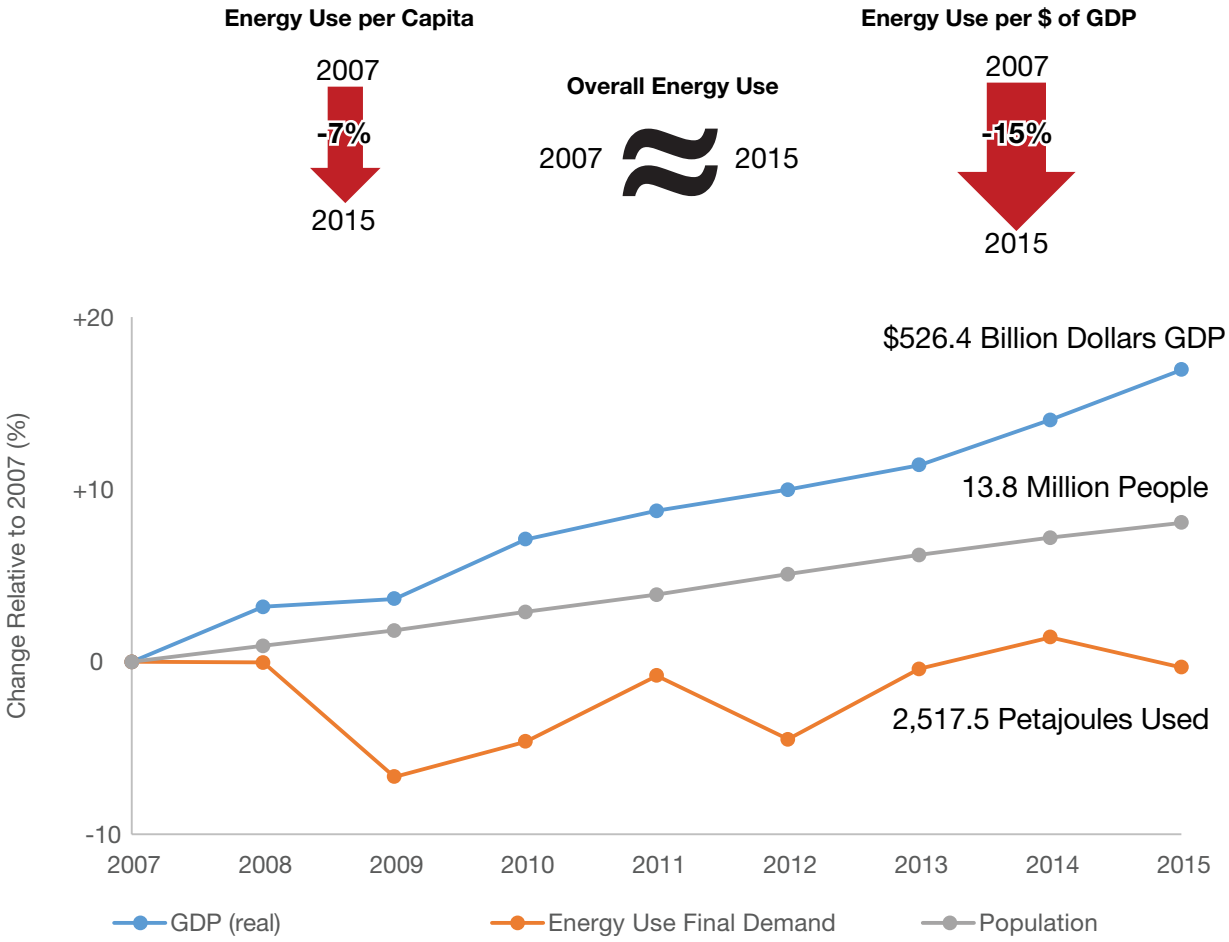

Figure 2.2. Ontario's overall energy use, population and GDP (2007-2015).

Note: 2015 energy use data is preliminary; it is likely to be revised (typically about 1-2%). Historical energy use (pre-2015) is periodically revised by Statistics Canada, so will differ slightly from what the ECO has reported in previous years.

Source: Statistics Canada, CANSIM tables 128-0016, 384-0038, and 051-0001.

The potential for improved energy efficiency in Ontario is substantial. A reduction of over 25% in electricity and natural gas use is economically viable by 2030,[3] and by 2025 new vehicles sold in Canada will be 50% more efficient than they were in 2008.[4] However, given the dominant role of fossil fuels in Ontario's energy mix, efficiency alone will not be enough to meet the province's greenhouse gas reduction targets. Significant fuel switching to cleaner, non-carbon based fuels will also be needed.

The potential for improved energy efficiency in Ontario is substantial.

2.2 Fuel-by-Fuel Use Changes

As discussed above, overall energy use in the province is affected by macro factors, like population and GDP. Individual fuel use changes lend themselves to a slightly more granular analysis, based on changes in five key factors:[5]

- **Building codes and appliance/vehicle standards** are set and occasionally updated by the provincial and federal governments with increasingly stringent energy efficiency requirements. These help drive technological innovation. For example, compared to 1990, clothes washers use about six times less electricity.[6] However, due to challenges in calculating the resulting energy savings for overall electricity and natural gas use, these standards will only be discussed in relation to transportation fuel use.
- **Pricing** can also influence how much and which type of fuel a customer uses, depending on how sensitive a customer's level of consumption is to a change in price. Pricing can be affected by market forces (supply and demand), government policy, taxes, and (in the case of Ontario's natural gas and electricity) the Ontario Energy Board (OEB). Ontario's recently established cap and trade system will also add additional costs to fossil fuel-based energy sources.
- **Weather** extremes can also drive increases in energy use, particularly natural gas use in the winter (Ontario's primary space heating fuel source), and electricity in the summer (Ontario's main air-conditioning source).
- The **makeup of Ontario's economy** can influence the type and amount of fuels used. For example, coke and coke oven gas (categorized under "other fuels") are used almost exclusively in heavy industry, like steel manufacturing.
- **Publicly-funded conservation programs for natural gas and electricity** form a core part of the ECO's reporting mandate, and are assessed in detail in Chapters 5 and 6 respectively. These programs provide a financial incentive for electricity and natural gas distributors to do something for which they would otherwise have no business case: reduce how much fuel their customers purchase from them.

  The ECO estimates that the electric and gas conservation programs offered since 2006 (by the Independent Electricity System Operator and electric and gas utilities) have resulted in overall energy use in 2015 being 3% lower than it would have been in the absence of conservation programs.

Below is a high-level analysis of Ontario's fuel-by-fuel use changes in 2015, taking into consideration the five factors outlined above (where practical).

Weather extremes can also drive increases in energy use.

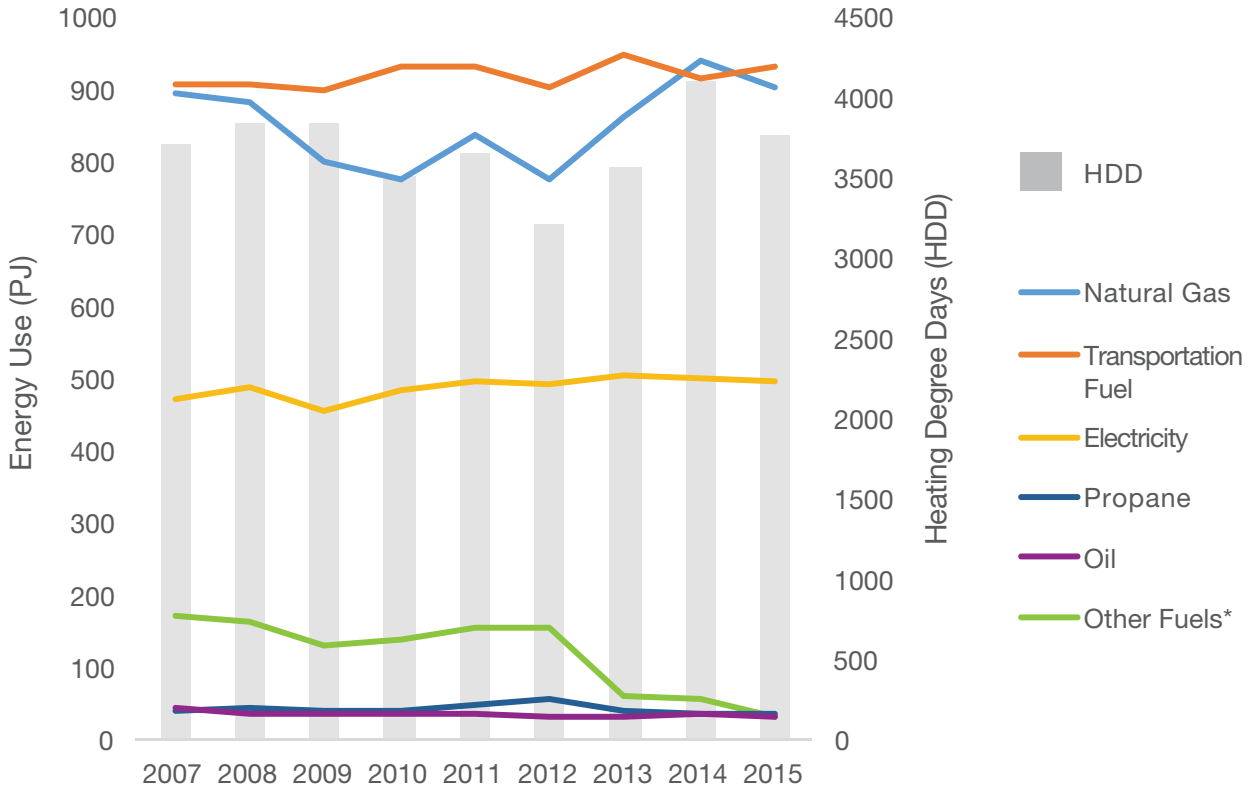

Figure 2.3. Ontario's energy use by fuel type in petajoules, and southern Ontario heating degree days (HDD) (2007-2015).

Note: 2015 data is preliminary, meaning it is likely to be revised (typically about 1-2%) within a year by Statistics Canada.

***"Other Fuels"** includes coal, crude oil, steam, petroleum coke, coke and coke oven gas. For the years 2013-2015, no data is available for coke use in Ontario, and for the year 2015, there is no data available for coke oven gas use.

Source: Statistics Canada, CANSIM table #128-0016; Environment Canada, Monthly Climate Summaries (heating degree days sourced from the Toronto International Airport weather station).

2.2.1 Transportation Fuel

At 39%, transportation fuel made up the largest share of Ontario's energy use in 2015. Its use increased by 2% from 2014 fuel use (from 915 PJ to 933 PJ). This was despite increasingly stringent fuel efficiency standards for new vehicles. In 2015, personal vehicles (including cars and light trucks) driven on Ontario roads were almost 20% more fuel efficient on average than in 1990.[7]

The increase in transportation fuel use may be explained by lower prices and more cars on the road. Gasoline prices were down 16% across Ontario in 2015 from the previous year.[8] Lower gasoline prices may influence transportation fuel use in several ways, for example individuals may choose to drive more and/or purchase less fuel-efficient vehicles. Diesel use is also increasing with freight truck use as Ontario's economy continues to grow and depend more on just-in-time delivery.[9]

Transportation fuel made up the largest share of Ontario's energy use.

2.2.2 Natural Gas

Natural gas use was down by 4% in 2015 (from 941 PJ in 2014 to 904 PJ in 2015). The decrease may have been a result of temperature changes and continued government-funded conservation programs.

Ontario's main energy source for space heating is natural gas. This means warmer winters can reduce natural gas use and vice versa. Heating degree days[10] in 2015 were down by about 8% in Ontario compared to 2014, which had a particularly cold winter.[11]

Conservation programs are offered by Ontario's major natural gas distributors, Enbridge and Union Gas. Since 2006, these programs have resulted in a reduction in overall natural gas demand in 2015 of about 6%. This is an average of less than 1% per year of program-related savings.[12]

The above factors may have been offset to some degree by declining natural gas prices. On average, across the province residential natural gas commodity rates in 2015 decreased by about 23% from 2014 rates (from 18.29¢/m³ to 14.12¢/m³). For residential customers, the commodity cost of natural gas was 84% less in 2014 than the cost for an equivalent amount of electricity (the most common alternative fuel source for home heating), and 89% less in 2015 (see Figure 2.4).[13] As we discussed in our special report, *Developing the 2017 Long-Term Energy Plan*, this price differential will need to be addressed if Ontario is to achieve the reduction in natural gas use necessary to achieve its GHG reduction targets.[14]

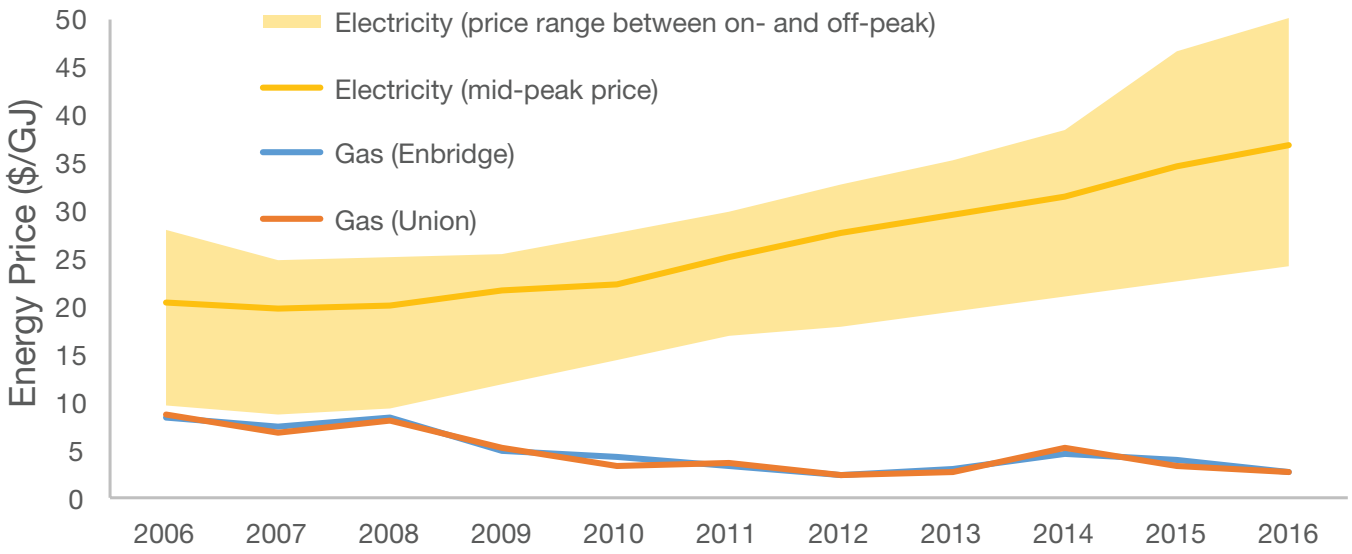

Figure 2.4. Ontario's annual residential time of use electricity prices compared to natural gas prices, per gigajoule (2006-2016).

Note: Does not include cost of delivery to end user.

Source: Ontario Energy Board.[15]

2.2.3 Electricity

Electricity use remained steady in 2015 (from 499 PJ in 2014, to 494 PJ in 2015).[16]

Electricity conservation programs run by local electricity distribution companies (LDCs) and the IESO between 2006 and 2015 resulted in 20.75 PJ of electricity savings in 2015 (4% of electricity use in 2015).[17] For a more detailed discussion of LDC-run electricity conservation programs, see Chapter 6. If we also consider codes and standards, pricing policies, and federal conservation programs, conservation savings totalled an estimated 48.7 PJ or 9.5% of electricity use in 2015.[18] For more details on progress towards province-wide electricity conservation targets, see Chapter 4.

The electricity supply mix (i.e., the type of generation from which electricity was produced) changed substantially year over year. This, despite total energy use remaining relatively stable. In 2015, there was an increase of more than 15% of electricity produced from embedded generation (i.e., distributed energy, connected to local distribution systems instead of the high-voltage transmission grid), from 5.1 TWh in 2014 to 6 TWh in 2015, the biggest increase being solar (see Figures 2.5 and 2.6). Coal finally went down to 0% of electricity production in 2015 (from 84 GWh, 0.1% of production, in 2014), bringing to a completion the province's coal phase-out that began in 2005. And, natural gas use for electricity generation (the most common source used to meet demand peaks) went up about 4%, despite a milder winter in 2015, which would be expected to reduce the use of peaking gas-fired generation.[19] This increase in natural gas may be partially explained by several scheduled nuclear maintenance shutdowns in September, as natural gas is a reliable electricity source available to fill this supply gap (see Figure 2.7).[20]

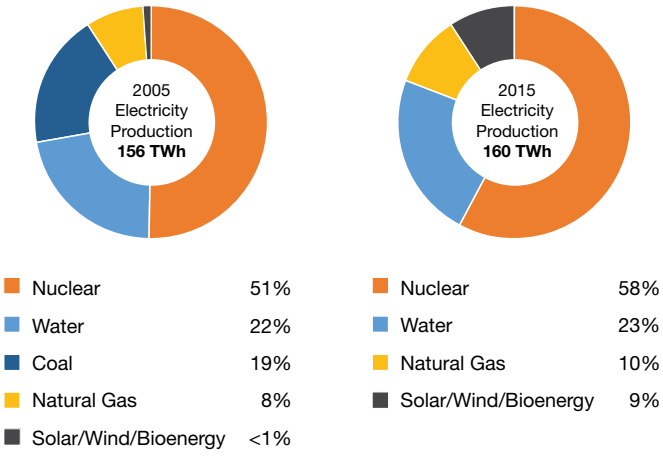

Figure 2.5. Ontario's electricity production by fuel source (2005 vs. 2015)

Note: Includes both electricity produced to meet Ontario demand (143 TWh in 2015, including embedded generation), and net exports (17 TWh in 2015).

Source: Independent Electricity System Operator, *Ontario Planning Outlook 2016*, Figure 2.

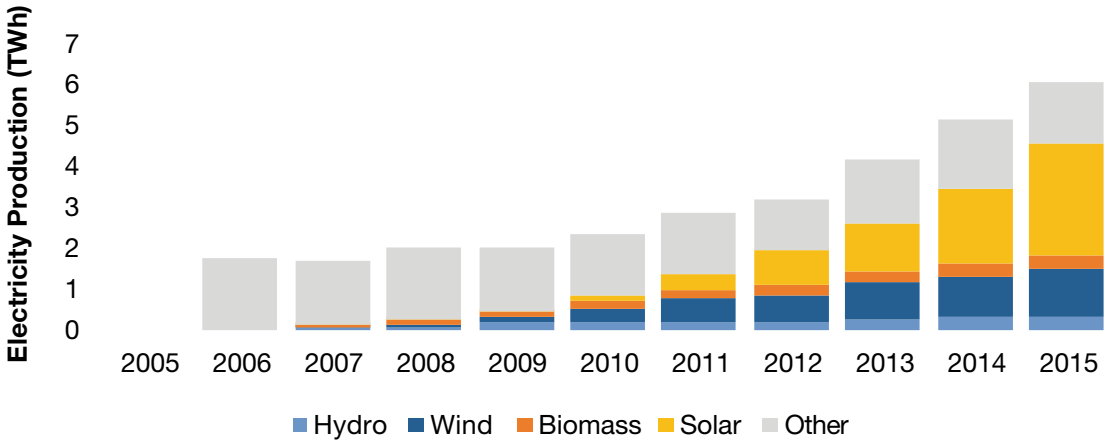

Figure 2.6. Annual distribution-connected (i.e., embedded) energy production in terawatt hours (Ontario, 2005-2015)

Note: "Other" includes resources that are distributed but not under an IESO contract or standard offer program. These are mostly distribution connected hydropower resources and some gas-fired generation (e.g., combined heat and power).

Source: Independent Electricity System Operator.

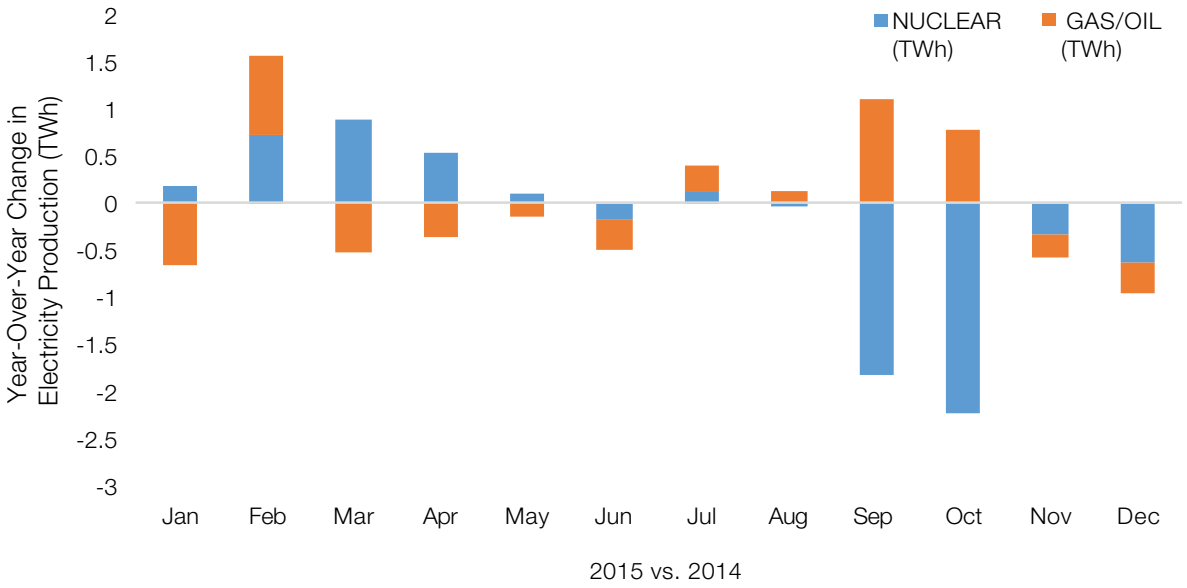

Figure 2.7. Year-over-year change in electricity production from nuclear and natural gas/oil in terawatt hours (Ontario, 2015 vs. 2014).

Source: Independent Electricity System Operator, month-by-month fuel output reports.

2.2.4 Propane, Oil, and Other Fuels

Propane use (typically for home heating in rural areas, or for mobile industry uses) remained steady (from 37 to 36 PJ). Oil use (typically for home heating) dropped slightly (from 35 to 31 PJ). As with natural gas, this reduction may be partially explained by a warmer winter. Ontario's remaining energy sources (i.e., "other fuels"), which include steam, crude oil, coal, petroleum coke, and coke oven gas, are not possible to analyze because Statistics Canada has not disclosed coke use data for 2013-2015 and coke oven gas data for 2015.

2.3 Sector-by-Sector Energy Use Changes

There was no significant shift in how energy use was distributed between Ontario's sectors (see Figure 2.8). The small shift in the industrial sector's fuel use is partially attributable to the missing coke oven gas data for 2015. The preliminary nature of the 2015 energy use data could also be partially responsible.

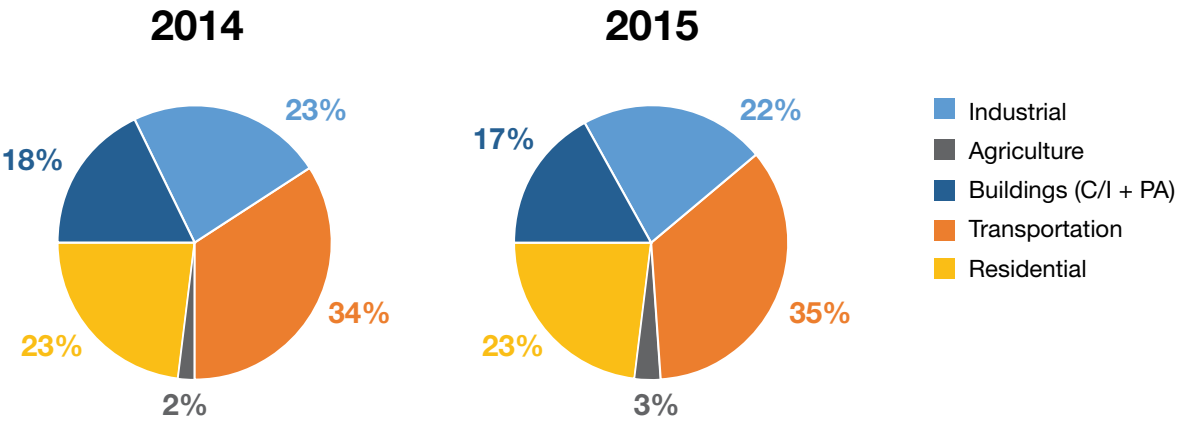

Figure 2.8. Ontario's fuel use by sector (2014 vs. 2015).

Note: 2015 data is preliminary, meaning it is likely to be revised (typically about 1-2%) within a year by Statistics Canada. "C/I + PA" stands for commercial/institutional and public administration.

Source: Statistics Canada, CANSIM table 128-0016.

2.4 Improvements to Electricity Use Reporting for Ontario

Where feasible, the ECO seeks to improve the quality of publicly available fuel use data for Ontario. Over this past year these efforts focused on improving Statistics Canada's electricity use data by initiating communication between Statistics Canada and Ontario's Independent Electricity System Operator (IESO). As a result, Statistics Canada has significantly adjusted its electricity use numbers for Ontario for 2009-2015.

The macro-adjustment made by Statistics Canada to its electricity use data going back to 2009 included:

- accounting for electricity used by local distribution companies (LDCs) on the low voltage grid, and
- using IESO data as a control for Statistics Canada's survey-based electricity generation and imports and exports data.

As Table 2.1 (below) makes clear, the data from both sources is still not exactly aligned.

Table 2.1. Statistics Canada's 2017 Methodological Change: 2014 Case Study

Ontario 2014 Electricity Use Final Demand		
Preliminary (Statistics Canada)	117.888 TWh	+17.5%
Adjusted (Statistics Canada)	138.587 TWh	-3.8%
IESO (including embedded generation, not including off-grid generation)	143 TWh	

Source: Statistics Canada and Independent Electricity System Operator.

According to Statistics Canada, IESO data was not adopted wholesale for the following reasons:

1. IESO data does not account for off-grid electricity use;
2. Statistics Canada also benefits from survey-based data;[21] and
3. IESO had not provided its embedded generation data.

Going forward Statistics Canada has indicated that as part of its efforts to improve the quality of its electricity use data for Ontario, it has reduced the threshold of one of its feeder surveys to include more renewable energy companies and will continue its information sharing project with the IESO.

Endnotes

1. From 2,525 PJ in 2007 to 2,517.5 PJ in 2015. However, 2015 data is preliminary. Preliminary Data is typically revised within a year of publication, often by 1-2%. At the time of writing (mid-2017), preliminary 2015 energy use data for Ontario was the most current data available from Statistics Canada, which provides the only comprehensive and consistently reported energy use dataset available for Ontario. (Statistics Canada CANSIM table 128-0016.)

2. Population in 2007 was 12.8 million, in 2015 it was 13.8 million (Statistics Canada, CANSIM table 051-0001); From $450 billion to a $526 billion gross domestic product (expenditure-based, in chained 2007 dollars, as calculated by Statistics Canada, CANSIM table 384-0038).

3. 26.5% by 2030 for natural gas (ICF International, *Natural Gas Conservation Potential Study: Final Report* (2016) at iv); 31% by 2035 for electricity, which includes behind-the-meter generation and an assumption of 11% increase in electricity use (Independent Electricity System Operator, *Achievable Potential Study: Long Term Analysis* (25 November 2016) at 2, 5, and 43); greater efficiencies for both fuels are possible though not currently economical.

4. Government of Canada, News Release, "Harper Government Improves Fuel Efficiency of Canadian Vehicles" (27 November 2012).

5. There is some degree of efficiency that would take place independent of these five factors due to technical innovation.

6. Natural Resources Canada, *Improving Energy Performance in Canada, Report to Parliament Under the* Energy Efficiency Act *2-13-2015* (Ottawa: NRCan, 2016) Figure 2.

7. "Comprehensive Energy Use Database", Transportation Sector, Ontario, Table 9: Road Transportation Secondary Energy Use and GHG Emissions by Energy Source (comparing 1990 to 2014), online: Natural Resources Canada <oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm>.

8. "Fuel Prices", online: Ontario Ministry of Energy <www.energy.gov.on.ca/en/fuel-prices/?fuel=REG&yr=2014>.

Average annual regular unleaded gasoline price ($)	2014	2015	% change 2014 → 2015
Northern Ontario	133.2	111.3	-16
Southern Ontario	126.8	104.7	-17

9. Ministry of Transportation, *Freight Supportive Guidelines* (Toronto: MTO, 2016) at 9-10.

10. Heating degree days is a measure of the annual sum of the degrees of the average daily temperature for all days below 18 °C. The higher the HDD value, the colder the location. ("Climate Zones", online: Natural Resources <www.nrcan.gc.ca/energy/products/categories/fenestration/13954>.)

11. "Monthly Climate Summaries", online: Government of Canada <climate.weather.gc.ca/prods_servs/cdn_climate_summary_e.html>.

	Toronto Int'l Airport Weather Station		Timmins A Weather Station	
Year	Heating Degree Days	Cooling Degree Days	Heating Degree Days	Cooling Degree Days
2014	4,103	264	6,502	56
2015	3,766	351	5,975	102
% Change 2014→ 2015	-8	+33	-8	+82

12. Enbridge Gas Distribution, *2015 Demand Side Management Draft Annual Report* (Scarborough: EGD, 22 April 2016) Table 3-8; Union Gas, *2015 Demand Side Management Draft Annual Report* (Chatham: UG, 22 April 2016) Table 3-8. (6% is based on adding annual net natural gas savings from 2007-2015, compared to overall natural gas use in 2015).
13. Based on a comparison of energy equivalent commodity prices that excludes delivery to the end user.
14. Environmental Commissioner of Ontario, *Developing the 2017 Long-Term Energy Plan* (Toronto: ECO, December 2016) at 13.
15. "Historical Natural Gas Rates", online: Ontario Energy Board <www.oeb.ca/rates-and-your-bill/natural-gas-rates/historical-natural-gas-rates>; "Historical Electricity Rates", online: Ontario Energy Board <www.oeb.ca/rates-and-your-bill/electricity-rates/historical-electricity-rates>.
16. Although Ontario's Independent Electricity System Operator electricity demand data is different and potentially more accurate (518 PJ in 2014 to 515 PJ in 2015), for consistency purposes across fuels, we enlist Statistics Canada data for our macro-level analysis of Ontario's energy use. Both sources indicate that electricity use reduced slightly from 2014 to 2015 (>1%). (Independent Electricity System Operator, *Ontario Planning Outlook* (Toronto: IESO, September 2016) Figure 4 and Appendix B, Module 2, slides 6 and 7.)
17. Independent Electricity System Operator, information provided to the ECO in response to ECO inquiry (21 March 2017). (5,763 GWh = 20.75 PJ, which represents 4% of IESO's electricity use data for 2015.)
18. *Ibid.* (13,530 GWh = 48.7 PJ, which represents 9% of IESO's electricity use data for 2015.)
19. Independent Electricity System Operator (month-by-month fuel output reports).
20. "Events Reporting: Nuclear Power Plants" online: Canadian Nuclear Safety Commission <nuclearsafety.gc.ca/eng/acts-and-regulations/event-reports-for-major-nuclear-facilities/event-reporting/nuclear-power-plants.cfm>.
21. Statistics Canada uses data it receives from the Annual Supply and Disposition Survey, which takes into account: (1) producer consumption (i.e., electricity consumed by a business for its own use); (2) LDCs on the low voltage grid; (3) transmission losses.