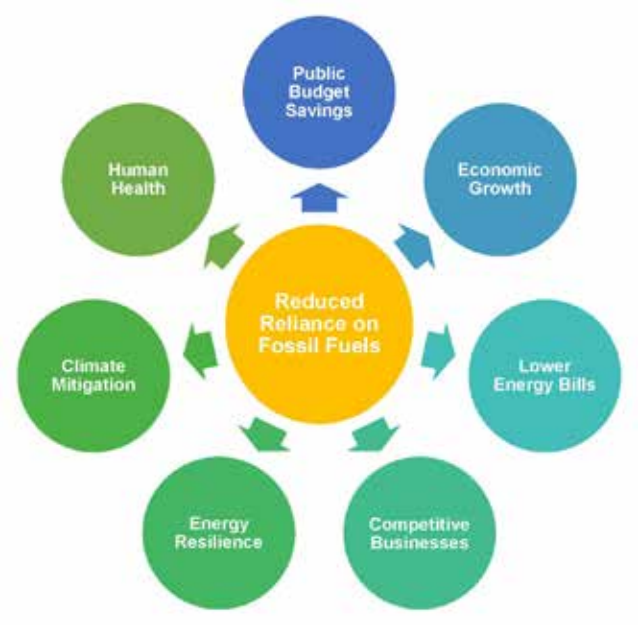
A Healthy, Happy, Prosperous Ontario

Why we need more energy conservation

2019 Energy Conservation Progress Report

Environmental Commissioner of Ontario



Summary of Recommendations

The ECO recommends that the Government of Ontario follow these evidence-based best practices:

1. Significantly reduce Ontario's bill for importing fossil fuels through energy conservation and fuel switching. Set targets for reducing Ontario's use of each fossil fuel, track and report progress.

2. Deliver its planned 3.2 megatonnes of greenhouse gas reductions from conservation programs by:
   a. growing natural gas conservation funded by ratepayers
   b. including conservation of other heating fuels and fuel switching
   c. focusing electricity conservation on programs that save electricity during hours of high demand, when fossil fuels are being used to generate electricity, and
   d. accurately measuring and valuing greenhouse gas reductions.

3. Slash the energy needed in older homes by improving more building envelopes during planned renovations, by ensuring that:
   a. buyers know the energy use of their potential home, and homeowners have reliable information about the financial and well-being benefits of efficiency improvements
   b. efficiency improvements are easy and low-risk for homeowners to finance
   c. the Building Code sets minimum levels of efficiency in renovated homes, and
   d. renovation professionals have energy efficiency capacity and expertise.

4. Provide homes and jobs for the growing population, without locking them into sprawl, congestion and gridlock, by:
   a. removing regulatory obstacles to adding density into areas with existing transit and jobs, thus creating more housing in compact, complete communities with a lower total cost of living
   b. revising population allocations in the Growth Plan to direct much more growth towards these compact communities
   c. limiting development of new suburbs and requiring them to have densities of residents and jobs that support frequent transit
   d. requiring transit-supportive densities around transit stations and corridors as a condition of provincial funding, and
   e. regular, credible reporting of the Growth Plan's performance in sustainably managing growth.

Environmental Commissioner of Ontario | Commissaire à l'environnement de l'Ontario

March 2019

The Honourable Ted Arnott
Speaker of the Legislative Assembly of Ontario

Room 180, Legislative Building
Legislative Assembly
Queen's Park
Province of Ontario

Dear Speaker,

In accordance with section 58.1 of the Environmental Bill of Rights, 1993 (EBR), please find enclosed the 2019 Energy Conservation Progress Report for your submission to the Legislative Assembly of Ontario. This is my last report as the Environmental Commissioner of Ontario.

The 2019 Energy Conservation Progress Report is my independent, non-partisan, expert review of Ontario's progress in conserving energy. This report focuses on the fossil fuels that supply 75% of Ontario's energy and that we most need to conserve, especially gasoline, diesel, and natural gas.

In summary, **if the government follows evidence-based best practices and takes appropriate action, energy conservation can help Ontarians save money, reduce climate damage and increase their health and well-being.** Three key, time-sensitive "win-win-wins" would come from improving utility conservation programs, helping homeowners include deep energy efficiency in the renovations of existing homes, and directing growth to existing urban areas with jobs and transit. Ontario could be on the road to a clean economy but is currently headed in the wrong direction.

It has been a great privilege to serve you and the Ontario Legislature as Environmental Commissioner. Thank you and best wishes.

Sincerely,

D Saxe

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Environmental Commissioner of Ontario

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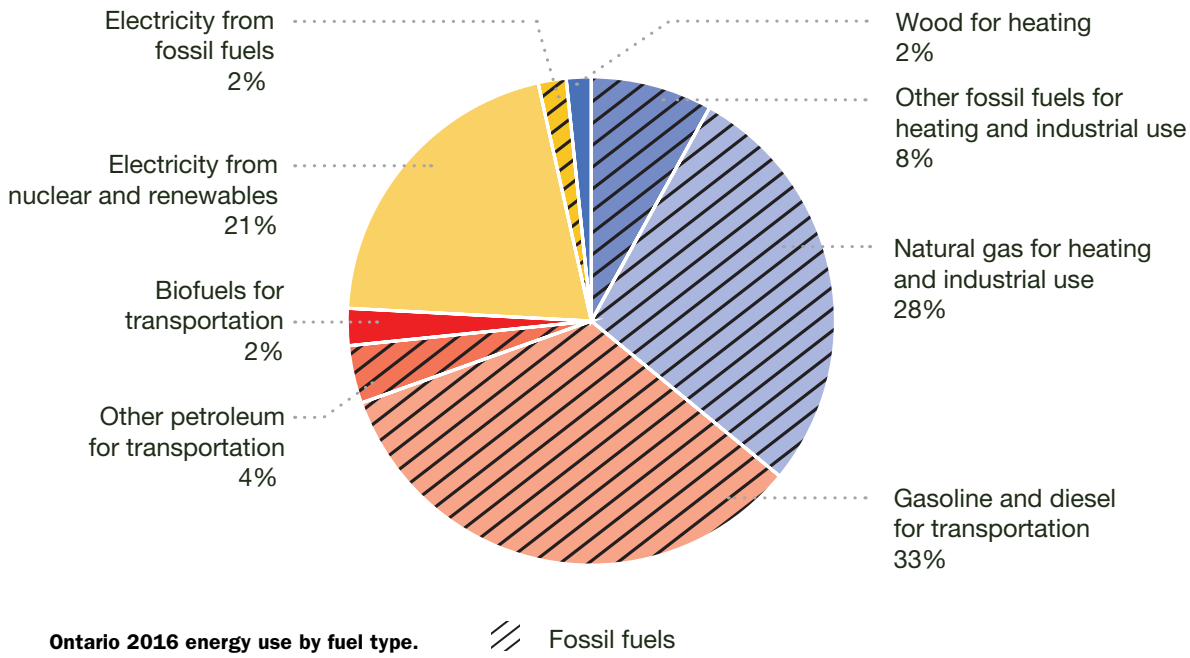
Dianne Saxe
Environmental Commissioner
of Ontario

1. Why Ontario needs energy conservation



Ontario 2016 energy use by fuel type.

While renewable energy use has grown over the past decade, Ontario's economy is still 75% dependent on fossil fuels, mostly petroleum products and natural gas. This is not good for our economy, for our climate, for our health or for our well-being and will not be sustainable as climate change gathers speed.

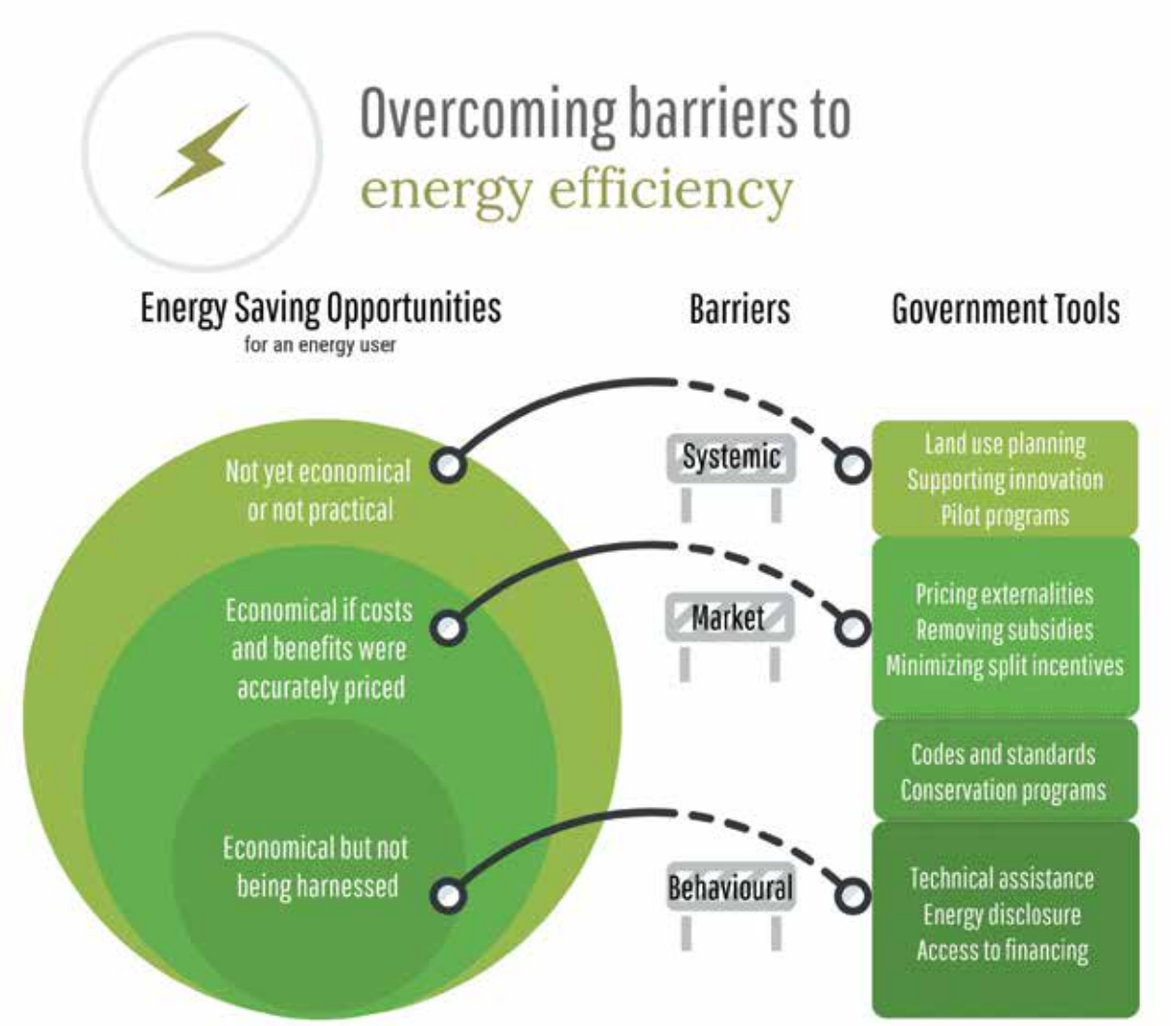
The world's leading climate scientists have shown why the whole world must dramatically slash its use of fossil fuels before 2030, i.e., during the next twelve years. Ontario can do that. The key is much more energy conservation (including efficiency), plus switching from fossil fuel use to Ontario's clean electricity, geothermal, biomass and other renewables.

Energy conservation has tremendous potential to save money, reduce Ontario's heavy dependence on imported fossil fuels, create jobs, improve public health and reduce pollution of our air and climate. For example, Ontario spends $16 to $24 billion every year to import fossil fuels; conservation could keep a growing share of this money in the pockets of Ontario

families and businesses. Burning those fuels creates significant health risks, particularly for those who live or work close to heavy traffic or who spend long hours commuting on busy roads. Children and seniors are especially vulnerable.

Why does Ontario waste so much energy, and leave so many cost-effective energy conservation opportunities unused? Wise energy use depends on good public policy. Ontarians face behavioural, systemic, and market barriers to reducing energy waste, and need supportive government action to overcome them.

Yet, Ontario recently cancelled its climate-polluter-pay system, and most other programs to reduce fossil fuel use. Without effective government action to conserve energy, especially fossil fuels, Ontario will continue to damage its finances, climate and well-being.



Overcoming barriers to energy efficiency.

2. Making utility conservation more effective

Ontario's electricity and natural gas utilities operate successful conservation programs that have produced significant environmental benefits plus several dollars of savings for every dollar spent. Without the past decade of conservation programs, Ontario's electricity and natural gas use would now be roughly 7% higher, and Ontario's climate pollution would be about 6 megatonnes (Mt) CO_2e higher. Conservation programs can do even more.

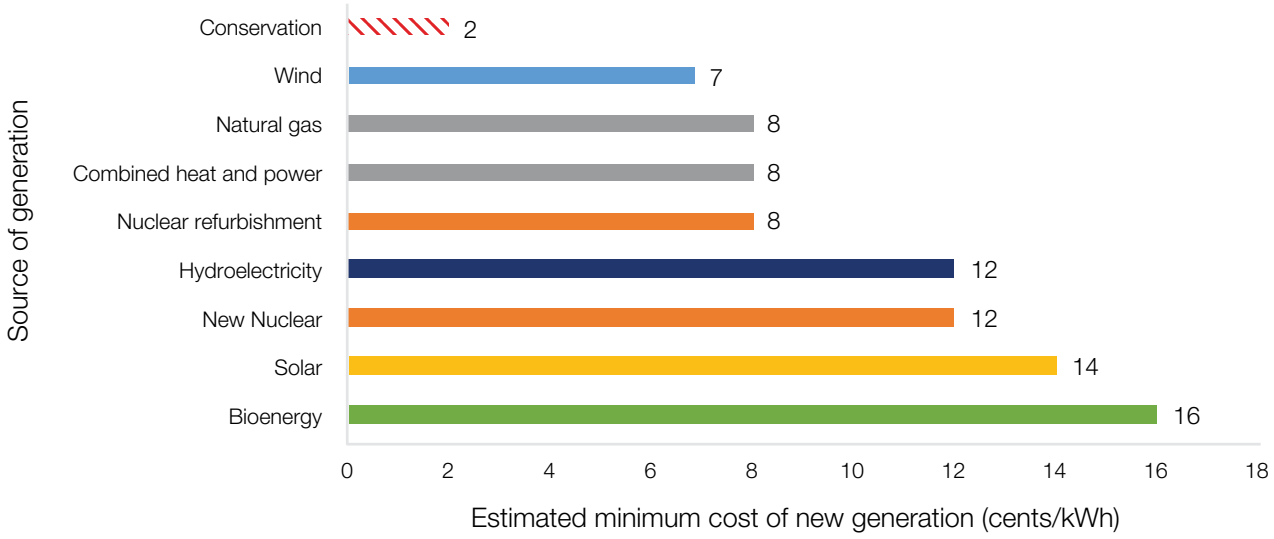
Electricity conservation has been better funded than gas conservation for a decade, because of the supply crisis that Ontario's electrical system faced in the early 2000s. This seems likely to change. The government's November 2018 draft Environment Plan ignores electricity conservation, but counts on expansion of utility natural gas conservation programs to reduce Ontario's annual greenhouse gas emissions by 3.2 Mt by 2030.

Utility-funded conservation programs can deliver this reduction. Natural gas is a fossil fuel, and Ontario's second largest energy source; reducing its use has climate and air pollution benefits as well as financial ones. There are even greater benefits from reducing other fossil fuels used for space heating, such as propane and oil, by increasing efficiency and/or switching to cleaner energy sources. Expanding conservation programs to include these other fuels could minimize the cost of the 3.2 Mt emission reduction, although this is challenging in the current utility-delivered structure.

Electricity conservation programs can and should produce more economic, climate and environmental benefits by being focused on times of high demand, the only times that Ontario burns fossil fuels to make electricity. However, cancelling electricity conservation outright would increase annual emissions by 2 Mt by 2030, offsetting most of the benefits of expanding utility conservation of natural gas.

Why does Ontario still need electricity conservation? First, it saves money. Costs have dropped dramatically; more than ever before, conservation is the cheapest electricity resource.

Second, conservation helps keep the lights on when the weather is very hot or very cold, times when the electricity grid strains to assure everyone a reliable electricity supply. While some think that Ontario has more electricity than we need, this is only true some of the time, i.e. during those hours when Ontarians do not use much electricity, such as spring, fall and weekends.



Estimated minimum cost of new electricity generation in Ontario, 2016.

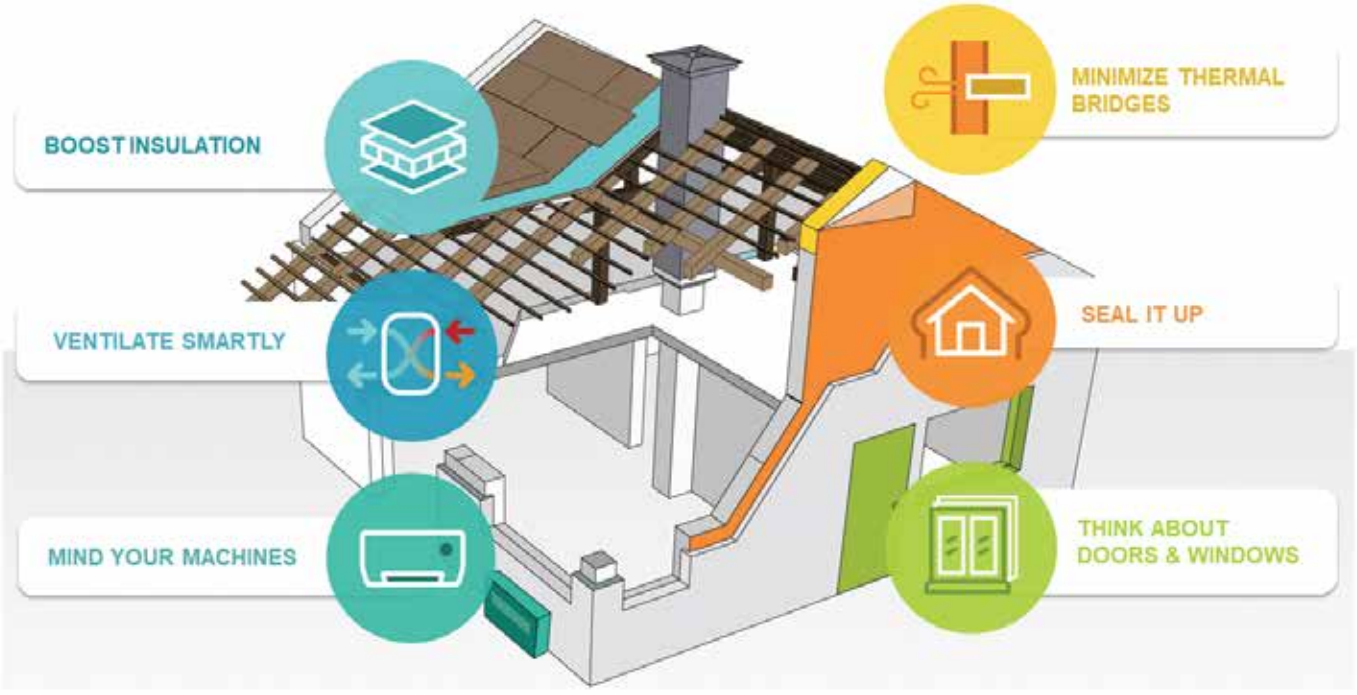
3. Older homes: the renovation opportunity

Older Ontario buildings use unnecessarily large amounts of energy, mostly fossil fuels. This is especially true for one important group of older Ontario buildings – existing low-rise homes. The 85% of Ontario homes built in or before 2005 use at least twice as much energy (as modelled) as those of the same size built today.

Slashing the energy needed in existing homes can make them more comfortable and more resilient, lower utility bills, and increase resale values, while growing the renovation economy and reducing climate pollution. Most people would prefer homes that are draft-free, warm in the winter and cool in the summer, and inexpensive to keep that way. Every Ontario home has the potential to be like that, but most are not.

Ontario's energy conservation programs have already led to some improvements in existing buildings, especially in their lighting, furnaces, and air conditioners. But deep energy efficiency, to make buildings more than 30% more efficient, can typically be achieved only by improving the building envelope: the walls, roof, floors, doors and windows. To date, Ontario conservation programs have done little to improve building envelopes in existing homes, yet serious progress in reducing their energy use and climate impact is not possible without taking this step.

Ontario misses a crucial opportunity when energy efficiency is left out during renovations. Ontarians love to renovate their homes; an estimated one-third of dwellings underwent some renovation in 2017. Modest government policy changes could help homeowners make energy-efficient building envelopes part of planned renovations, when improvements are cheaper and less disruptive.



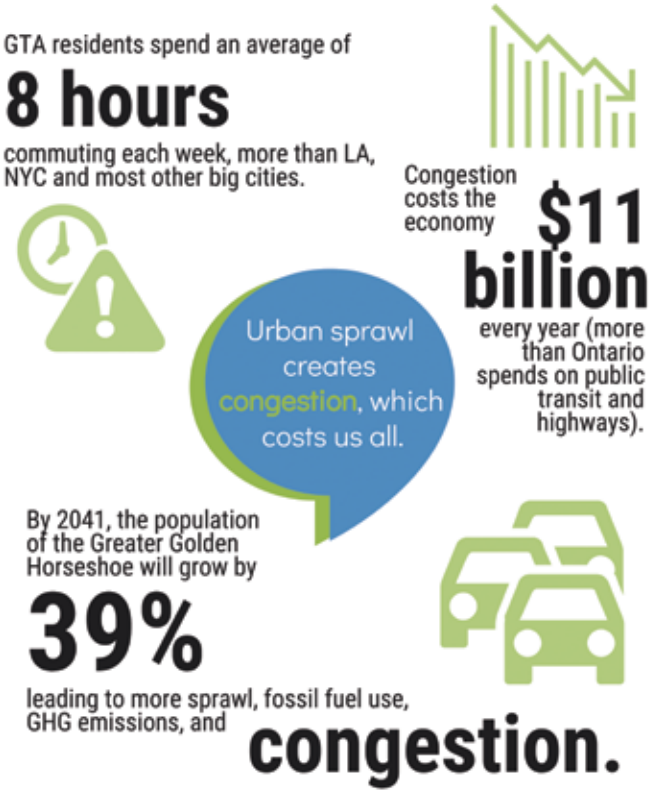
Recommendations for energy efficiency in homes primarily focused on improving the building envelope.

Source: Energy Step Code Council, Energy Step Code.

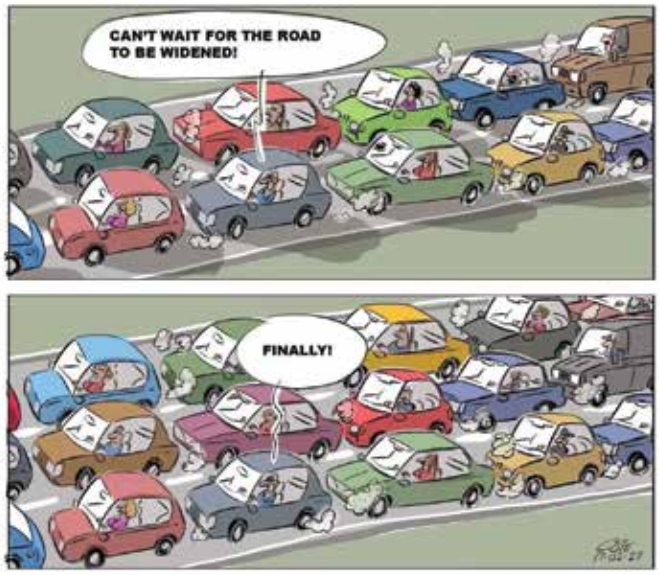
4. Urban sprawl: the road to gridlock

Petroleum fuels used for transportation, like gasoline and diesel, are Ontario's largest energy sources and the primary sources of its climate and air pollution. Today, Ontario is doing little to reduce consumption of these fuels. Instead, government policies drive up their use by favouring costly and destructive urban sprawl, which also destroys farmland, forests and wetlands.

Ontarians drive a lot, creating congestion and air and climate pollution, because urban sprawl has spread out the places they need to go. Most Ontarians live inconveniently far from jobs, grocery stores, libraries, and schools, because government decisions about land use and transportation have given them no real alternative. Now they are locked into car-based commutes that are ever longer and more congested, commutes that are going to get worse.



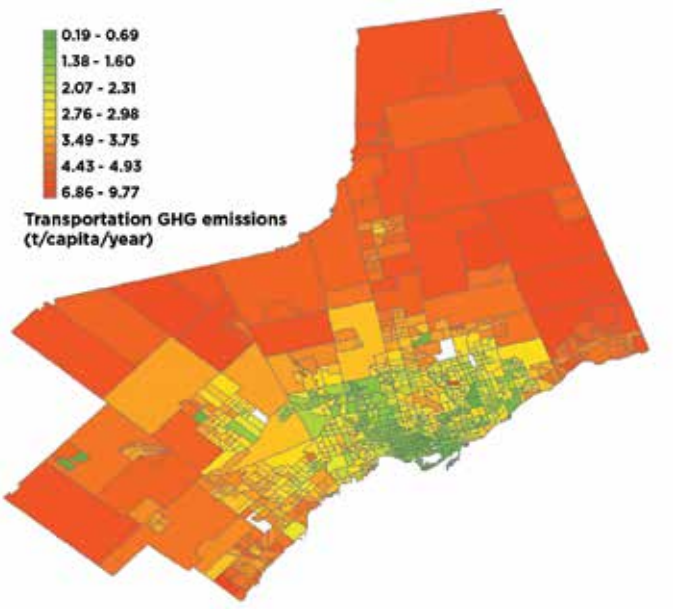
Ontario's land use plans are creating urban sprawl, which will increase the already high costs of congestion.



It is now widely accepted that building or expanding roads does little to alleviate traffic congestion.

Credit: André-Phillippe Côté.

The Growth Plan for the Greater Golden Horseshoe is supposedly designed to prevent urban sprawl, and to accommodate the growing population in compact, complete communities with a high quality of life. Instead, the plan actively increases sprawl, directing hundreds of thousands of people to new distant suburbs with high transportation-related fossil fuel use and greenhouse gas emissions (see figure below), high servicing costs, few employment opportunities, and densities too low to support public transit.



Per capita annual transportation greenhouse gas emissions in the Toronto Census Metropolitan Area (includes private automobiles and public transit). Emissions can vary by at least a factor of ten based on residents' location, transportation options, and urban density.

Source: Jared VandeWeghe and Christopher Kennedy, "A Spatial Analysis of Residential Greenhouse Gas Emissions in the Toronto Census Metropolitan Area" (2007) 11:2 Journal of Industrial Ecology 133-144.

Contrary to good planning and to best practices, the government is proposing to weaken the Growth Plan to allow even more sprawl, spreading new suburbs over yet more farmland, forests and wetlands. This will lengthen commutes, increase congestion, and drive up fossil fuel use (and therefore climate and air pollution), while also reducing resilience to floods and increasing costs for municipalities. Ample evidence shows it will not be possible to solve this congestion by building more roads.

Ontario can and should accommodate its growing population without creating further urban sprawl and gridlock. There is room to add the housing that we need in compact, complete communities while revitalizing the inner suburbs and other built-up areas that today are stagnant or losing population. Removing regulatory obstacles to medium-density housing (that is neither tall nor sprawl) in existing areas can shorten commutes, reduce fossil fuel use, help address high living costs, and protect natural areas and farmland.

Appendices

This report contains four appendices of information related to energy conservation progress in Ontario that are available online at eco.on.ca/reports/2019-why-energy-conservation.

- **Appendix A.** A summary of the changes to energy policy that occurred in Ontario in 2017 and 2018. Related changes to climate change policy were described in the ECO's 2018 report Climate Action in Ontario: What's Next?
- **Appendix B.** Statistics on Ontario's progress towards meeting any government-established targets for reducing the use or making more efficient use of electricity, natural gas, propane, oil and transportation fuels, based on latest available data. Because of the change in provincial government in 2018, some of these targets may be under review.
- **Appendix C.** The 2016 and 2017 quantitative results of electricity conservation programs funded by electricity ratepayers. These include programs delivered to customers by local distribution companies (LDCs) and the Independent Electricity System Operator (IESO), and market mechanisms to curtail electricity use at times of peak system demand.
- **Appendix D.** The 2016 quantitative results of natural gas conservation programs funded by natural gas ratepayers.

Summary of Recommendations

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1. Why Ontario needs energy conservation

Abstract

Energy conservation and efficiency have tremendous potential to save money, reduce Ontario's dependence on imported fossil fuels, create jobs, improve public health and reduce pollution of the air and climate. Why, then, does Ontario waste so much energy, and leave so many cost-effective energy conservation opportunities unused?

Wise energy use is highly dependent on good public policy. Government action is needed to help overcome the behavioural, systemic, and market barriers that lead to energy waste. Ontario's electricity and natural gas conservation programs (operated by utilities) have produced significant economic and environmental benefits for a decade, but Ontario recently cancelled most other programs to reduce energy waste. Conservation programs are only one tool in the government's toolkit; codes and standards, access to energy data, and land use planning are among the many other ways government can help overcome barriers to energy conservation. Without effective government supports for conservation of all forms of energy, especially fossil fuels, there will be continued damage to Ontario's economy and climate, as well as the well-being of Ontarians.

Natural gas conservation programs can and should do much more than they do now, and electricity conservation should be better focused. Electricity conservation produces important economic and environmental benefits at times of high electricity demand (usually hot or cold weekdays), but few at times of low demand (usually nights and weekends, especially spring and fall). **Chapter 2** explores how utility natural gas conservation programs can produce the 3.2 megatonnes of annual reductions in greenhouse gas emissions by 2030 as estimated by the government's draft Environment Plan. Among other things, meeting this target will require serious attention to deep energy efficiency retrofits of existing buildings, starting with typical homes (**Chapter 3**).

Petroleum products, like gasoline and diesel, are Ontario's largest energy sources and the primary sources of its climate pollution. Today, Ontario is doing little to reduce consumption of these fuels. **Chapter 4** shows that current government policies will, instead, drive up fossil fuel use in transportation, creating congestion, air and climate pollution and gridlock.

Contents

Ontario wastes energy whenever more of it is used than needed.

1.1 Ontario wastes a lot of energy

Ontario wastes energy whenever more of it is used than needed.[1]

This chapter examines:

1. How much energy does Ontario waste?
2. What are the financial, climate and well-being benefits of conserving energy (especially fossil fuels), i.e., using it more efficiently and only when needed?
3. What is Ontario currently doing to conserve energy?
4. What barriers get in the way of conserving more energy, and what can government do to reduce them?

What do we mean by conserving energy?

Throughout this report, the ECO uses the terms "energy conservation" and "energy efficiency" interchangeably to describe managing and restraining society's energy consumption, whether we are discussing individual or system-wide measures, and whether we are talking about technology, economics or behaviour.

Experts in the energy field often use these terms to describe specific mechanisms for reducing energy consumption. For example, "energy efficiency" often refers to technology that uses less energy to achieve the same or better outcomes, such as replacing an incandescent or fluorescent lightbulb with an LED lightbulb, or making productive use of leftover heat.

"Energy conservation" often refers to behavioural changes, such as turning off lights in empty rooms, wearing a sweater or cycling to work. It can also mean reducing the need for energy, such as building complete communities so that people do not have to drive to work. For electricity, conservation can also mean changing the time that energy is used, since the financial and environmental impacts of electricity use vary substantially between on peak and off peak. "Fuel switching" is also a kind of conservation that changes the source of energy to one that is more efficient or has a lower environmental impact, such as buying an electric car instead of one fueled by gasoline.

Strong government policy is needed to support energy efficiency and conservation.

This chapter does not focus on the differences between these various mechanisms, each of which is necessary to reduce fossil fuel dependence and mitigate climate change. Instead, it focuses on the need for strong government policy to support all forms of energy efficiency and conservation.

1.1.1 How much energy is Ontario wasting?

A good start: Energy use intensity has improved

Ontario's overall energy use has remained relatively flat over the past decade, despite a growing population and economy. Put differently, energy intensity – the amount of energy consumed per person or per dollar of economic output – has improved (i.e., decreased). As compared to 2007, each person in 2016 used 10% less energy and each dollar of additional economic

output required about 19% less energy (the latter is about a 2% improvement per year, on average) (see Figure 1.1). This improved energy intensity is due to several factors, including structural changes in Ontario's economy, market demand for more efficient technology in response to higher energy prices, and effective government policies, regulations and utility-run conservation programs.

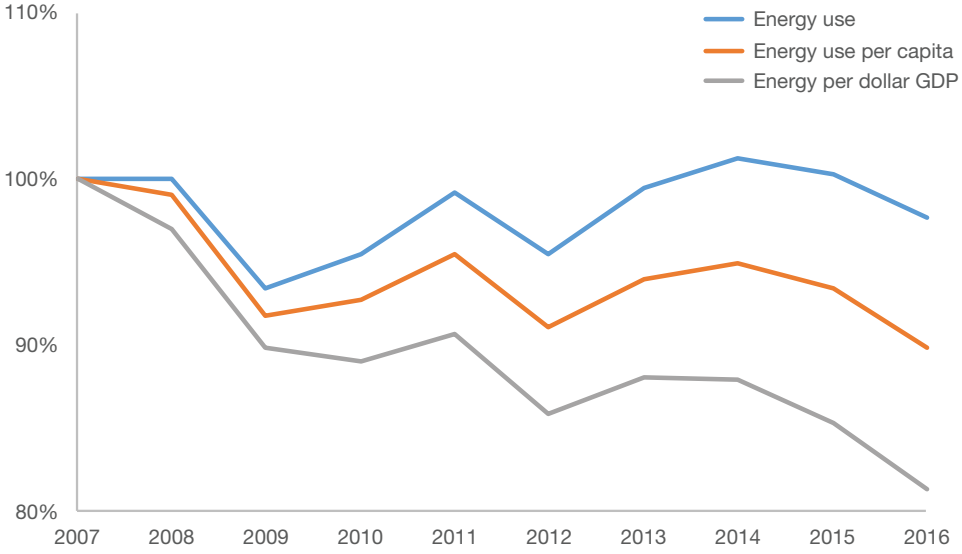


Figure 1.1. Overall energy use and percentage change in Ontario's energy use per person (2007-2016) and per dollar of gross domestic product (GDP). Note: Energy use data includes the largest source of renewable energy, hydroelectricity, but excludes the other relatively minor sources.

Source: Statistics Canada, Table 25-10-0029-01 Supply and demand of primary and secondary energy in terajoules, annual; Statistics Canada, Table 36-10-0222-01 Gross domestic product, expenditure-based, provincial and territorial, annual (x 1,000,000); Statistics Canada, Table 17-10-0005-01 Population estimates on July 1st, by age and sex.

A similar trend has been occurring globally. Energy use per dollar of global gross domestic product has fallen by about 2.2% annually since 2011. Figure 1.2 shows examples of decreased energy intensity in other developed economies.

Figure 1.2. Primary energy demand, GDP, and energy intensity in the European Union and United States (2000-2017).

Source: International Energy Association, Energy Efficiency 2018: Analysis and outlooks to 2040, at 19.

Some of these savings occurred without government intervention, often in response to technological advances and rising energy prices. For example, even before the existence of energy efficiency standards, appliance efficiency increased. However, additional savings were triggered by government policies, like increasingly stringent building codes and appliance standards, and other conservation policies and programs. This is why experts forecast energy use based on a combination of projected energy savings from government conservation measures (i.e., regulations, standards, polices, and programs), as well as market-driven energy efficiency. Conservation program evaluations try to untangle these factors, but this can be difficult.

Improved energy intensity is possible.

How much more energy efficient could Ontario be?

More savings are achievable. According to the International Energy Agency the world is falling short of achieving all economically viable energy efficiency, which would look more like a 3% annual decrease in global energy intensity, rather than the current average of 2.2%, which is similar to the rate of decline Ontario has seen. This improved level of energy intensity is possible. There are other similar jurisdictions (both economically and geographically) that are showing the way. Compare, for example, Ontario's energy use intensity to that of the United Kingdom, Germany, France, Denmark, Netherlands, or Norway (see Figure 1.3).

The potential exists to reduce electricity use 31% and natural gas 26.5% over the next two decades.

Existing studies of Ontario's energy efficiency potential relate only to electricity and natural gas, which together represent half of Ontario's energy use (see Figure 1.4). These studies were undertaken to develop targets for utility-run conservation programs (see **Chapter 2** for a discussion of how utility-run conservation programs can be optimized). According to these studies, the potential exists to reduce electricity use 31% and natural gas 26.5% over the next two decades, at the same cost or less than the fuel and energy supply infrastructure that would otherwise be used.[2] However, this will not happen on its own. Government policy and programs are needed to spur efficiencies beyond those that occur naturally.

Comprehensive conservation potential studies have not been undertaken for other fuels, like Ontario's biggest source of energy and greenhouse gas (GHG) emissions: petroleum transportation fuels (see Figure 1.4).

In short, there is significant energy waste occurring in Ontario.

Conservation potential studies have not been undertaken for other fuels.

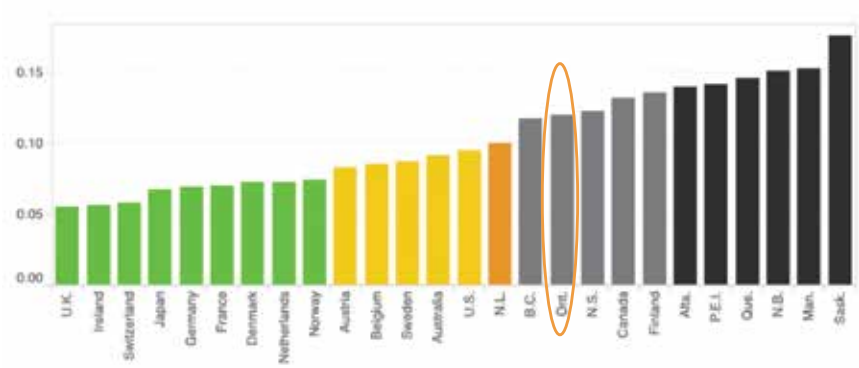


Figure 1.3. The 2014 (or most recent) energy intensities of Canadian provinces and countries in similar climate zones. Note: Final energy demand in tonnes of oil equivalent per US$1,000 GDP.

Source: Conference Board of Canada, How Canada Performs: A Report Card on Canada, online.

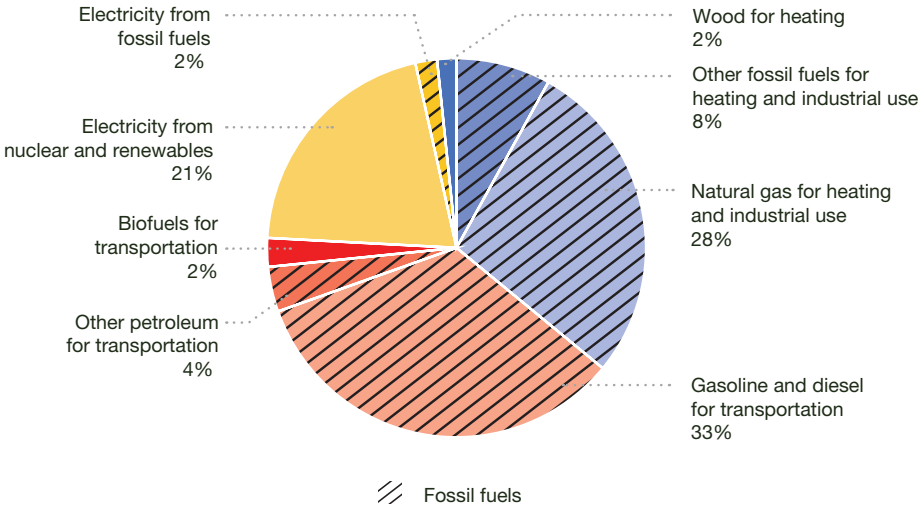


Figure 1.4. Ontario 2016 energy use by fuel type. Note: Total for "electricity from fossil fuels" is secondary energy use, not primary energy use. "Other fossil fuels for heating and industrial use" may include a small amount of biomass for industrial use.

Sources: Statistics Canada, Table 25-10-0029-01 Supply and demand of primary and secondary energy in terajoules, annual; Natural Resources Canada, Comprehensive Energy Use Database, Residential Sector, Ontario, Table 1; Independent Electricity System Operator information request; Ministry of the Environment, Conservation and Parks information request.

1.1.2 How much has conservation helped?

While some of the improvement in Ontario's energy intensity is due to a shift in Ontario's economy away from energy-intensive manufacturing to the less intensive service sector, it is also due to improved efficiencies. In the residential and transportation sectors, for example:

- trucks used 31% less energy in 2016 than in 1990 per tonne-kilometre of freight shipped
- cars in Ontario used 18% less energy to drive a passenger the same distance in 2016 than in 1990, and
- Ontario homes consumed 37% less energy (per square metre) in 2016 than in 1990.[3]

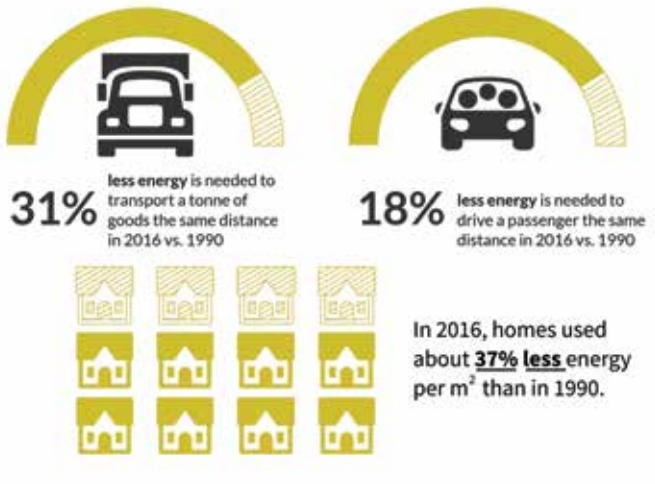


Figure 1.5. Energy uses in Ontario over time.

Source: NRCan, Comprehensive Energy Use Database.

On the other hand, Ontario's commercial and institutional sector has increased its energy use per square metre over 5%. This has been driven by a tripling of auxiliary equipment energy use, which is likely related to increased reliance on data servers.[4]

These improvements in energy efficiency are holding energy use in the province relatively flat, despite population and economic growth (see Figure 1.1), helping avoid the need for new energy supply and distribution infrastructure. But there is potential to do much more.

Electricity conservation: why timing matters

Ontario's ability to store electricity is still very limited, although it is improving. By and large, enough electricity needs to be produced at all times to match the instantaneous demand. Ontario's demand for electricity on a hot summer day or cold winter evening can be twice as high as it is on a mild spring or fall night. Meeting Ontario's electricity needs at times of high demand is very expensive and drives the need for Ontario to build new generation to maintain reliability. It is also environmentally damaging, as fossil-fuelled electricity generators run primarily in these hours. Therefore, conservation at times of high demand has greater environmental and economic benefits. **Chapter 2** discusses how to improve electricity conservation programs to focus on conservation during hours of high demand.

1.2 Benefits of wasting less energy

To the extent that government has a reasonable opportunity to reduce energy waste, there are many excellent reasons for these interventions.

Energy efficiency improvements in Ontario would enhance economic growth.

1.2.1 Money

Net growth in jobs and GDP

Economic modeling predicts that energy efficiency improvements in Ontario would enhance economic growth, as measured by net jobs and gross domestic product (GDP). These net totals account for any potential job or GDP losses that might occur because of a commitment to energy efficiency (as opposed to gross totals, which do not). By 2030, the quite modest energy efficiency commitments envisioned by the federal Pan-Canadian Framework on Clean Growth and Climate Change are estimated to result in net growth in jobs of about 53,000 and net growth in annual GDP of $12.5 billion in Ontario.[5]

Some of these positive economic impacts (e.g., new jobs in the energy efficient sector) are due to direct investments in conservation measures. However, most of the positive economic impacts are caused indirectly by the money saved from lower energy bills (not rates, which ignore consumption; bills can go down due to reduced use even if rates go up). These savings can be spent however one chooses, including improving business competitiveness. (Conservation programs deliver both direct and indirect benefits; see for example the textbox "Energy managers: helping Ontario businesses stay competitive.")

When the goal of energy efficiency policy is net energy reductions, then the potential for increased energy use from this spending must be taken into account (see the textbox "What about rebound?" in section 1.2.3.)

Energy managers: helping Ontario businesses stay competitive

Energy managers have the potential to bring huge value to individuals, businesses, and the economy at large.

Enviro-Stewards is an energy and resource management firm located in Elmira, Ontario. They help find financial savings through more efficient use of energy and other inputs, and are paid out of the savings they produce. These savings help companies increase their bottom line and become more competitive. Enviro-Stewards states that average payback for their customers is less than one year.

Photo credit: Beau's Brewery.

For example, Beau's Brewery in the Ottawa area found enough financial savings through better efficiency to increase its productivity by 7% – enough to accommodate the company's entire projected growth for 2019. It expects the costs of the project to be repaid by reduced energy, water and food use in 9 months.

Another of their clients, Southbrook Vineyards, which was already LEED-Gold certified, wanted to achieve further energy efficiencies before investing in solar panels. A comprehensive energy audit found significant energy savings with a payback period of only 4 months. This saved half an acre of productive vineyard that would have otherwise been converted to solar panels (to provide the balance of the electricity required to operate the winery). This project won a national award from Clean 50.

Figure 1.6. The role of energy managers.

Source: Independent Electricity System Operator.

Enviro-Stewards is just one example of Ontario's diverse and growing energy management sector. In 2018, there were about 1,000 certified energy managers in the province.[6] About 100 of these are hired by the Independent Electricity System Operator's SaveOn Energy program.[7] Training for the energy manager profession is also growing, in part due to support from utilities. In 2017, the Independent Electricity System Operator subsidized energy management training for 825 individuals across the province.[8] According to the Canadian Institute for Energy Training (CIET), numbers in their energy management courses have grown six-fold in six years, from about 124 in 2011, to 772 in 2017. These courses include but are not limited to energy management certification.[9]

Energy conservation leads to lower energy bills.

Energy conservation leads to lower energy bills, both because it reduces the need to build expensive new energy infrastructure (e.g., pipelines, generating stations, transmission lines), and because it reduces the use of the commodity fuels. Energy efficiency that reduces fossil fuel use also has the added benefit of potentially keeping more money in Ontario and improving the province's energy security. In 2015, Ontario spent about $16.8 billion on net imports of fossil fuels (i.e., crude oil, refined petroleum products and natural gas). As one of the leading global consulting firms, McKinsey and Company, reported in 2010:

> By focusing funding on energy-efficiency initiatives, governments hope not only to save or create jobs – the primary goal of the spending – but also to reduce domestic dependence on foreign energy supplies and reduce carbon emissions associated with energy use.[10]

Despite the overall net economic and environmental benefits associated with energy efficiency, narrowing the energy efficiency gap would eventually mean the loss of jobs in some energy production fields. The government can help ensure workers benefit from a just transition to a more efficient and low-carbon economy.

Government can help ensure workers benefit from a just transition to a more efficient and low-carbon economy.

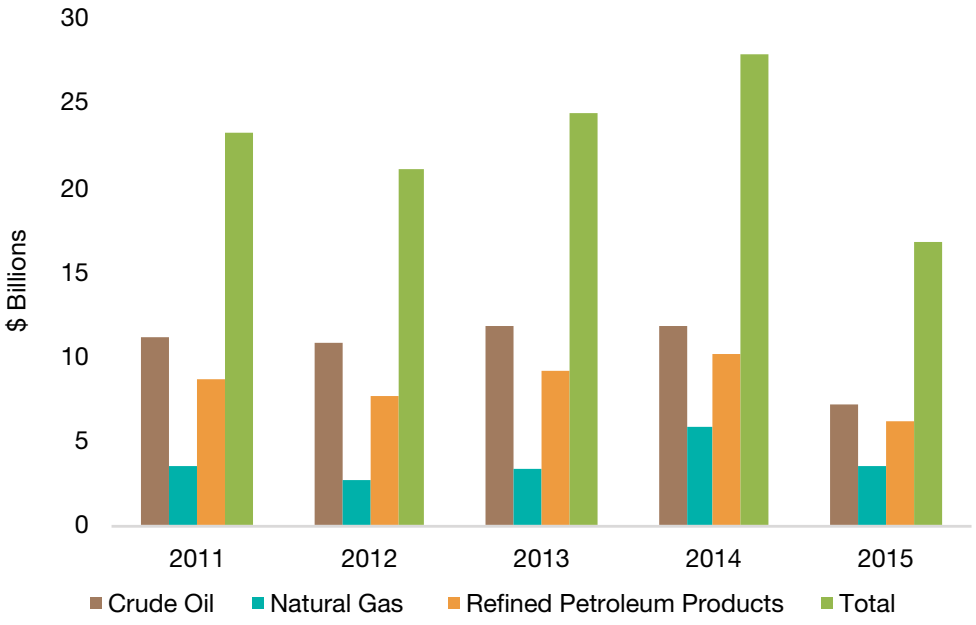


Figure 1.7. Estimate of Ontario's net annual fossil fuel import costs for the years 2011 to 2015, by fuel type.[11]

Source: Statistics Canada, Table 12-10-0088-01 Interprovincial and international trade flows, basic prices, summary level (x 1,000,000); Canadian Association of Petroleum Producers; and National Energy Board.

Energy efficiency fuels the success of businesses.

Improving competitiveness and attracting investment

Energy efficiency fuels the success of businesses in two key ways. First, it reduces company overhead, which frees up extra money that businesses can invest back into staff, equipment, or pass on to customers. All these investments have the potential to fuel a company's competitive advantage. For Ontario's manufacturing sector in particular, reduced energy costs via improved efficiency can help some companies make the important choice to keep their production lines in the province.

Second, energy efficiency efforts can help maintain and attract new investors. Increasingly, investors are looking for improved sustainability efforts from companies. In response, companies are amplifying their sustainability efforts and communicating them publicly, which has the added benefit of helping garner community buy-in. Energy efficiency is a clear win-win, financially and for public relations. See the textbox "Big industry evolves into culture of energy conservation: Samuel, Son & Co." for an example of how one industry player is prioritizing and communicating its energy efficiency efforts.

Big industry evolves into culture of energy conservation: Samuel, Son & Co.

Samuel, Son & Co. is a major North American metal service centre and manufacturing company, with over 115 plants across the US, Mexico and Canada, 13 of which are in Ontario. It was founded in 1855 in Toronto, at the site of the city's famous flatiron building. The metal it processes and the metal products it manufactures in Ontario serves, among others, the automotive, rail, and heavy construction industries.

The company's Ontario plants have successfully participated in many electricity and natural gas utility-run conservation programs over the years. After seeing the positive effect these programs had on the environment, as well as company cost savings, executives decided to go one step further and undertake their own independently-funded program. In 2017, Samuel, Son & Co. implemented their Energy Coach program at eleven of their North American plants, four of which are in Ontario (Markham, Burlington, Hamilton, Stoney Creek). According to the company, utility run conservation programs are typically about projects, but this program has a bigger goal – it's about making conservation part of the company's culture.

"We want our employees to feel knowledgeable about energy and how it is used by our plants and equipment," says John Lennartz, Vice President Engineering & Quality, who is leading the company's energy initiatives. "With this knowledge, employees have a better understanding of how making small changes can have a big impact on the environment and the amount of energy we use, which is important to us."

Photo credit: Samuel, Son & Co.

The program in question, Energy Coach, involves multi-disciplinary teams (i.e., from operations, maintenance, finances and the executive) assessing plant energy use to identify low-cost

operational, recommissioning and retrofit energy saving opportunities. An energy consultant, 360 Energy, was hired to provide training and manage each plant's energy team. Most initiatives are expected to have less than a 3-year payback, but projects with up to 5-year paybacks are considered. The program is meant to help employees understand that utility costs are controllable.

One example of a measure adopted in the program's first year is the 'stop light program.' It involves equipment and breakers being identified with green, yellow and red stickers. Green you can turn off, yellow ask a supervisor and red don't touch. This allows for increased conservation that is in the hands of the average employee.

The program, which started as a one-year pilot, has been extended for another three years, with projected returns of 5% energy savings a year. Energy efficiency and greenhouse gas reductions will form key parts of the company's 2019 Corporate Social Responsibility Program.

Ontario's growing efficiency sector

Investments in energy efficiency benefit most sectors of the economy, but they particularly benefit Ontario's growing efficiency sector. In this report, the efficiency sector includes those companies that develop technology or provide services designed to reduce (or complement the reductions of) energy use. The energy efficiency sector has significant crossover with the cleantech and construction sectors.

Ontario has a growing efficiency sector.

The efficiency sector has grown, and is expected to continue growing significantly. Exact numbers to date are hard to find, since the sector is not yet tracked in Canada.[12] The U.S. government only began tracking the efficiency sector in 2018, and found that, of all the energy subsectors, energy efficiency added the most – over half – new jobs in 2017.

The cleantech sector has been studied more because of its profitable export potential. As a result, there is more local data on job numbers. According to the provincial government, Ontario's cleantech sector has "$19.8 billion in annual revenues and over 5,000 companies employing 130,000 people."[13] The City of Toronto has recently started tracking growth in its green sector (which includes cleantech and renewable energy) and has already found employment growth far ahead of the annual average. For example, employment in Toronto's green sector grew by 6.5% between 2016 and 2017, as compared to the 2.1% average employment growth across all sectors between 2012 and 2017.[14]

According to the Conference Board of Canada, the government has a key policy role to play to enable the cleantech sector to grow to its full potential.[15] For a key example of Ontario's burgeoning energy efficiency sector, see the textbox "Ontario's cleantech sector success: ecobee smart thermostats".

Ontario's cleantech sector success: ecobee smart thermostats

A prime example of Ontario's success in the growing cleantech sector is the smart-thermostat company ecobee. Founded 10 years ago, ecobee now has over 350 employees and competes globally with the likes of tech giants like Google. It is a major player in a sector slated for major growth; the global smart-thermostat market accounted for US$1.3 billion in 2017. By 2024, the market size is expected to reach US$7.9 billion.[16]

Smart thermostats can produce significant (up to 23%) heating and cooling energy savings (the biggest home energy uses). Not only that, they can produce these savings in a way that maximizes resident comfort and financial savings. Customers can instruct their thermostats to function according to their specific preferences and the thermostats, in turn, can instruct their owners how to maximize energy and cost efficiency by taking into account applicable energy rates and weather reports.

As of 2017, ecobee was growing at 100% a year.[17] Its customers have extended beyond Canada into much of the U.S., where it captures about 17% of the smart-thermostat market. The provincial government has helped support its development in numerous ways, including direct funding through the Smart Grid Fund and featuring its products (as one of three eligible products) in a utility-run conservation program.

Reduced operational spending for public services

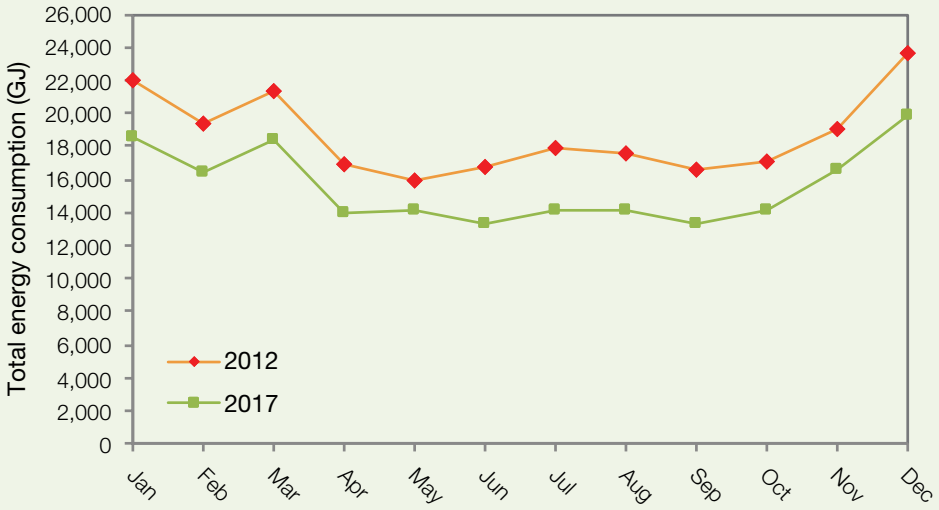
Energy conservation efforts undertaken by Ontario's public sector and broader public sector can reduce spending on energy bills, freeing up more money to deliver public services. The ECO has previously shown the potential for up to $450M each year in energy bill savings for Ontario's broader public sector.[18] The textbox "Grand River Hospital (Kitchener-Waterloo): big savings from energy efficiency" highlights the savings that public sector energy optimization projects can achieve.

Grand River Hospital (Kitchener-Waterloo): big savings from energy efficiency

Photo credit: Grand River Hospital.

Since 2012, Grand River Hospital in Kitchener-Waterloo has been undertaking a series of energy efficiency projects, supported by the Greening Health Care initiative. The aim of this work was to allocate less of their budget to energy use, and more to better patient care.

As of 2017, the hospital reduced its energy consumption by 16.5% compared with 2012, saving more than $850,000 in annual utility costs and avoiding 1,210 tonnes of greenhouse gas emissions annually. About $150,000 of the money invested in these projects was from utility incentives, other funding was sourced from the hospital's energy conservation fund (created from savings from the avoided capital and operations costs of the hospital's energy optimization efforts).



Grand River Hospital annual energy savings

16.5% less energy

$850,000

1,210 t avoided GHGs

Figure 1.8. Total monthly energy consumption for Grand River Hospital in 2017, as compared to normalized baseline (2012, prior to energy conservation efforts).

Source: Greening Health Care.

The most significant single conservation project the Hospital undertook was hiring their own in-house Building Automation System technician. The hospital now gets full-time service with better knowledge of how the building systems function and align with occupied hours. It is also easier for operations staff to bring forward their energy conservation ideas, especially after receiving energy management training (50% of these training costs were offset by utility incentives). All changes are then able to be continuously monitored. As a result, the hospital optimized its air handling system, which reduced chiller loads so much the hospital was able to avoid $1.5M for a new chiller (the primary source of the energy optimization project funding referenced above).

Beyond the financial savings, these energy savings have also earned the hospital energy efficiency and sustainability awards over the years. The hospital has plans to continue to build on their energy efficiency successes, with many more energy optimization projects in the pipelines.

Ontario's energy sources in 2016 were about 75% fossil fuels.

1.2.2 Climate

Energy efficiency has a critical role to play in reducing Ontario's GHG emissions. Ontario's energy system is the biggest source of the province's GHG emissions – about 75%. In turn, Ontario's energy sources in 2016 were about 75% fossil fuels (see Figure 1.4), of which:

- 37% were petroleum transportation fuels (about 90% of which is gasoline and diesel)
- 28% was natural gas for heating/industrial use
- 8% were other fossil fuels for heating/industrial use (which include propane and industrial fuels like coke and coke oven gas)
- 2% were from fossil fuels used for electricity generation (about 6% of electricity in Ontario in 2016 was powered by fossil-fuelled generation, almost entirely natural gas).

The other approximately 25% of Ontario's energy use was from carbon-free electricity and renewable fuel sources - wood for home heating, and biofuels (such as ethanol and biodiesel) for transportation.[19]

According to the International Energy Association, energy efficiency has the potential to be the largest single contributor (about 40%) of the carbon reductions needed to achieve global GHG targets by 2030.[20] Recent Canadian-specific modeling shows the potential for efficiency to deliver 25-39% of the necessary 2030 GHG reductions.[21] These numbers do not include further emissions reductions that could occur if electricity conservation enabled more fuel switching from fossil fuels to electricity. More efficient use of Ontario's almost carbon-free electricity would help ensure there is capacity available to replace fossil-fueled energy uses (like cars and home heating). It would also help avoid the need for costly new generation infrastructure.

Ontario has recently replaced its once ambitious and legally binding GHG reduction targets with a single, non-binding, target that is more than 60% weaker.[22] Despite this, some conservation efforts appear to be a pillar of the government's approach to reducing GHG emissions. The province plans to rely on natural gas conservation to achieve almost one-fifth of its expected GHG reductions through 2030, as discussed in **Chapter 2**.[23] This maintained focus on natural gas conservation is important, and will require significant effort, investment and expansion to make the dramatic reductions that are necessary. However, natural gas conservation alone will not help Ontario transition to a low-carbon economy.

The World Health Organization has reported on "Gaining Massive Benefits from Tackling Climate Change".

1.2.3 Well-being

Health

The sources of climate change and air pollution that damage human health are broadly the same: polluting energy systems that depend on burning fossil fuels. The bottom line is shown in two key chapters from the 2018 World Health Organization report, Health and Climate Change, entitled:

- The Paris Agreement: The Strongest Public Health Agreement of the Century
- Gaining Massive Health Benefits from Tackling Climate Change.

As the World Health Organization report explains, measures that reduce fossil fuel use to meet the Paris Agreement climate targets, would produce health benefits worth roughly double what they cost.

> The severity of the impact of climate change on health is increasingly clear. Climate change is the greatest challenge of the 21st century, threatening all aspects of the society in which we live, and the continuing delay in addressing the scale of the challenge increases the risks to human lives and health. The drivers of climate change – principally fossil fuel combustion – pose a heavy burden of disease [...].[24]

Ontario has already experienced one part of this transition. In the early 2000s, coal burned for electricity was an important source of air pollution in Ontario, and the air was so filthy that it prompted strong protests from public health organizations. The elimination of coal-fired power by 2014 accounted for 24% of nitrogen oxide, 22% of sulphur dioxide and 29% of mercury reductions from Ontario's air.[25] All of these pollutants had major public health impacts, including respiratory and cardiovascular ailments, heart and lung disease, and premature death.

Today, fossil-fueled transportation is both one of Ontario's major sources of air pollution (which damages public health), and also its largest source of climate pollution.

The major air quality threats from transportation fuel combustion are nitrogen oxides (NO_x), volatile organic compounds (VOCs), and, particularly in the case of diesel, fine particulate matter ($PM_{2.5}$). The transportation sector accounts for about 28% of Ontario's VOCs. The major source (by far) of NO_x emissions in Ontario is the transportation sector at 69% (see Figure 1.9). Nitrogen oxides can irritate the lungs and lower resistance to respiratory infection. NO_x also leads to the production of ground level ozone and smog, which have further health impacts.

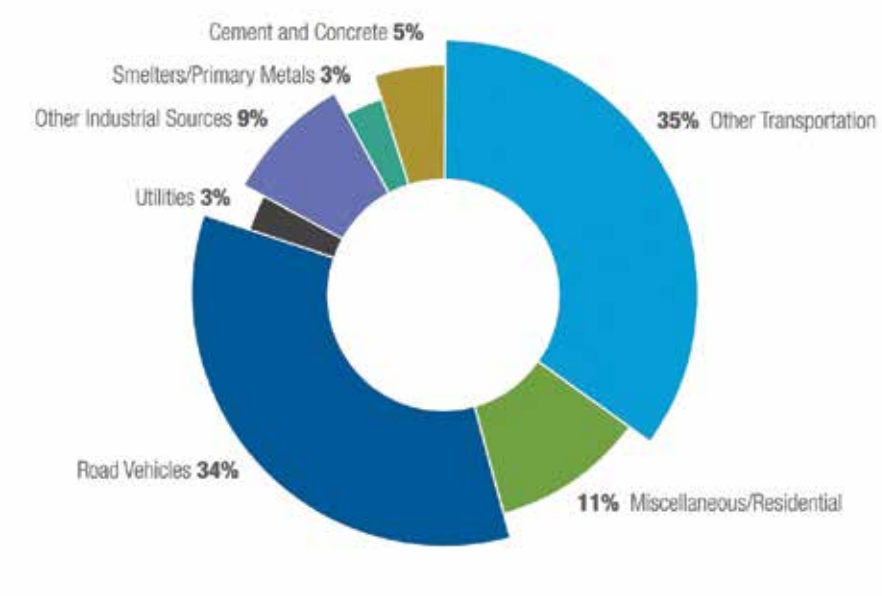


Figure 1.9. Ontario nitrogen oxides emissions by sector (2016 estimates for point/area/transportation sources). Note: Excludes emissions from open and natural sources.

Source: Ministry of the Environment and Climate Change, Air Quality in Ontario (2016) at 3.

The province's 2016 air quality report summarizes the health impacts of ozone as follows:

> Ozone irritates the respiratory tract and eyes. Exposure to ozone in sensitive people can result in chest tightness, coughing and wheezing. Children who are active outdoors during the summer, when ozone levels are highest, are particularly at risk. Individuals with pre-existing respiratory disorders, such as asthma and chronic obstructive pulmonary disease (COPD), are also at risk. Ozone is associated with increased hospital admissions and premature deaths.[26]

Gasoline and diesel combustion for transportation also produce fine particulate matter (about 12% of the province's total), and diesel engines create far more particles than do gasoline ones. $PM_{2.5}$ can have negative health effects on the respiratory and cardiovascular systems.

Traffic-related air pollution means significant health risks.

For those living or working close to heavy traffic (i.e., within 100 metres from a major road or 500 metres from a highway), or spending long hours commuting daily on busy roads, traffic-related air pollution means significant health risks. Unfortunately, these conditions are present for a large percentage of Ontario's population, including its most vulnerable: children, seniors and people with pre-existing health conditions.

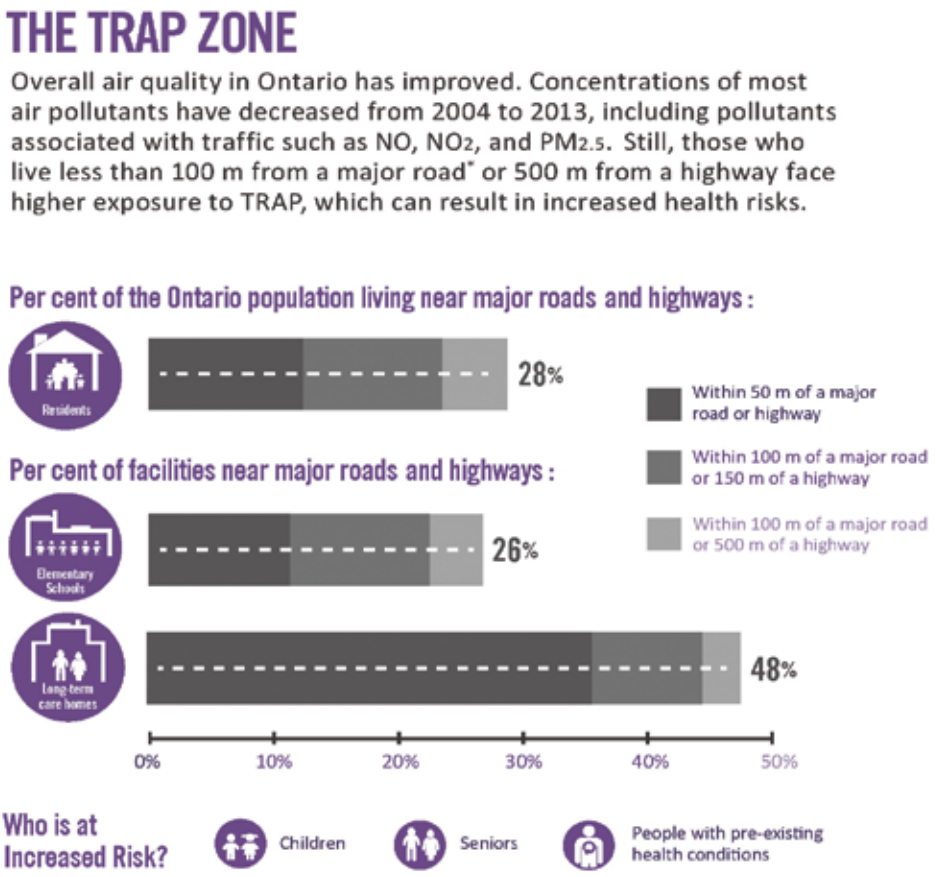


Figure 1.10. Traffic-related air pollution (TRAP).

Source: Public Health Ontario, Traffic-Related Air Pollution: Avoiding the TRAP zone.

For a sense of the magnitude of these health and economic impacts, for which statistics are not available at the provincial level, the City of Toronto's data is instructive. A 2014 Toronto Public Health Report found that trucks and cars account for 20% of premature deaths and 30% of hospitalizations related to air pollution.[27] Burning wood and home heating oil also create air quality impacts, but on a much smaller, more local scale. Burning natural gas, the second biggest source of energy in Ontario, causes significant air quality impacts, but releases much lower levels of the key toxins discussed above than burning equivalent amounts of gasoline and diesel. Simply put, reduced reliance on fossil fuels will not only play a key role in reducing Ontario's GHG emissions, but will also improve local air quality and public health.

More comfortable homes and lower bills

Avoiding wasteful energy use in your home can mean significant energy bill savings as well as other valuable benefits, like improved comfort and aesthetics. For example, upgrading heating and cooling systems can save homeowners $325 a year on energy costs, and also reduce cold drafts, maintenance costs, and noise.

Avoiding wasteful energy use in your home can mean significant energy bill savings, and improved comfort and aesthetics.

Reducing energy waste is particularly important for those living on less income.

It is difficult to put an accurate value on the non-energy benefits of conservation measures. Some customers value the aesthetic and comfort benefits of energy efficiency measures above the energy bill savings. Various studies have estimated that non-energy benefits add anywhere from 50% to 300% in value above the energy bill savings. In Ontario, utility-run conservation programs apply a blanket 15% non-energy benefit adder when calculating the value of conservation programs.

Reducing energy waste is particularly important for those living on less income, as it can mean freeing up money to cover other life necessities. This segment of the population also tends to live in older energy inefficient homes. About 14% of Ontarians are considered low-income (i.e., earning less than $22,657 after tax for a one-person household in 2016).[28] This number is also higher in certain regions, for example in Toronto, parts of southwestern and northeastern Ontario, and First Nation reserves, to name a few. If conservation programs are not specifically tailored for low-income customers, they are disproportionately more likely to be adopted by wealthier customers, thereby exacerbating the wealth gap. Beyond addressing wealth disparity, conservation programs targeted at low-income communities have many additional benefits, including reduced dependence on financial assistance, improved health outcomes, and reduced stress levels. Some great work is being done in Ontario to target some of the communities most in need (see, for example, the textbox "Nipissing First Nation Home Weatherization program" in **Chapter 2** of this report). But the need for low-income-targeted conservation programs far outweighs the available programming.

Less social conflict and natural heritage losses

Energy conservation can also provide significant social benefits from avoided social conflicts and natural heritage losses related to siting energy infrastructure. Siting energy infrastructure (whether poles and wires, transformers, pipelines, or new power generating facilities) is often the source of major community conflict, whether because of concerns for property value, health, and/or the environment.

Energy conservation can also provide significant social benefits.

Conservation has already avoided the need for major electricity infrastructure in Ontario. As of 2016, electricity conservation efforts (including codes and standards, utility-run conservation programs, and electricity pricing policies) were responsible for annual peak-electricity demand reductions of 4,148 MW, with the potential to activate another 640 MW if needed.[29] This is a very substantial amount. For comparison, the two natural gas power plants that were relocated from their originally planned locations in Oakville and Mississauga added only about 1,200 MW of peak electricity capacity combined.

All forms of electricity generation, even renewable sources, have negative environmental impacts, so the environmental benefit of avoiding the need for such a large amount of electricity generation is substantial.[30] Thus, reducing peak demand through conservation is not just a boon for the environment, for individual energy bills and the entire province's finances, it also reduces conflicts for residents and communities.

What about rebound?

One limitation of energy efficiency and conservation programs is that most environmental and climate benefits depend on reducing total energy use, especially fossil fuels. Energy efficiency alone does not necessarily reduce total energy use, because of population and economic growth. In some cases, energy savings from energy efficiency are also lower than expected due to a phenomenon known as the "rebound effect". Some rebound can be expected when:

- energy use has been limited by the cost of that energy, and
- efficiency makes energy use cheaper, by making a given amount of energy go farther and do more.

For example, a person who buys a more energy efficient car might drive more if the cost of fuel was a limitation on their previous driving. For this person, the more efficient car may not reduce their gasoline use. (This is called product-specific rebound.) On the other hand, a person who was already driving as much as they wanted to (or had time for) might keep driving the new car the same amount as before, while using less gasoline.

Rebound can also occur indirectly. The owner of a new, more efficient car who now buys less gasoline might spend the savings on something else that is equally or more energy intensive, such as flying somewhere on vacation.

Because of growth and the rebound effect, energy efficiency is not enough by itself to reduce fossil fuel use, deliver climate, health and environmental benefits, and to keep more money in Ontario. What energy efficiency does offer is a powerful way to protect standards of living and keep costs down for individuals and businesses and complement other measures, such as cap and trade or another way to price carbon pollution, that reduce air pollution and climate damage by reducing fossil fuel use.

Energy efficiency is a powerful way to protect standards of living and keep costs down and complement other measures that reduce air pollution and climate damage.

1.3 Conservation policy in Ontario today

How well is Ontario doing in reducing energy waste to date? This section provides some insight based on an analysis of the province's overall energy use trends. This is a top-down approach to assessing the province's progress on energy efficiency. The online appendices provide a more detailed analysis of utility-run conservation programs.

Fuel conservation policies have been in place in Ontario and across Canada since the 1970s. Below is a brief overview of the state of energy conservation policies by fuel. The Building Code and appliance standards are considered separately as they span multi-fuels.

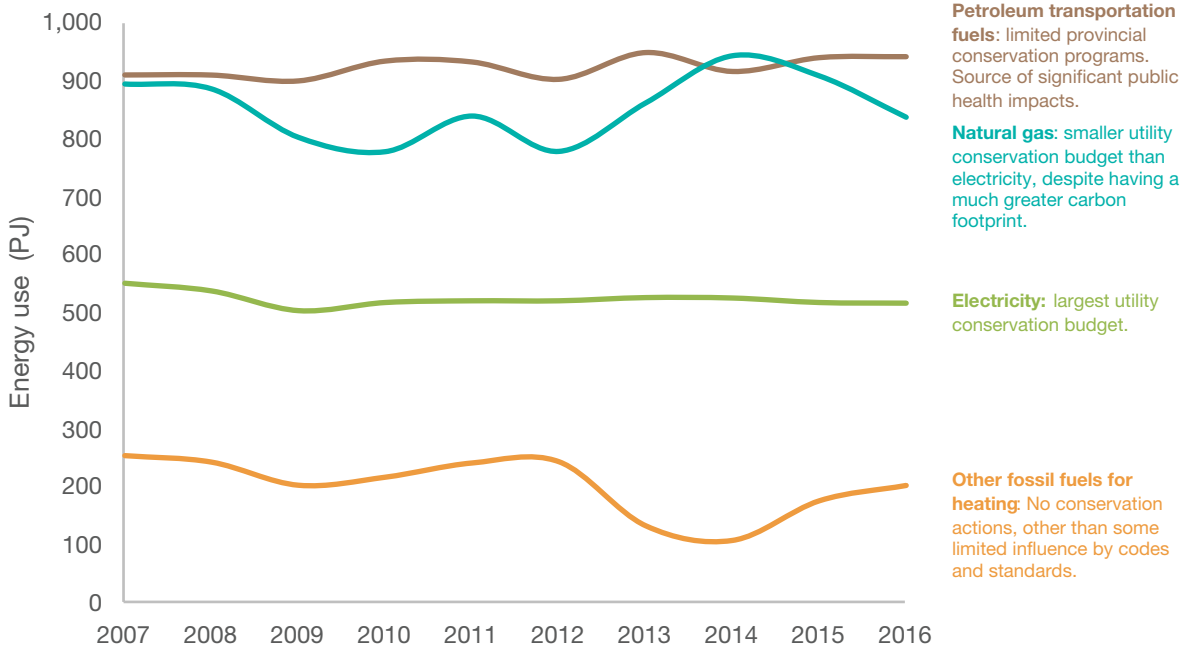


Figure 1.11. Ontario's annual energy use, by fuel type (2007-2016). Note: Due to historical data limitations for previous years, a relatively minor quantity of natural gas electricity generation appears in both the natural gas and electricity categories.

Source: Statistics Canada, Table 25-10-0029-01 Supply and demand of primary and secondary energy in terajoules, annual; Independent Electricity System Operator information request.

As shown in Figure 1.11, petroleum transportation fuel use has increased by 3%, electricity use has decreased 6%, while natural gas use has decreased 6% over the past decade.

Petroleum products used for transportation are the largest source of energy use and GHG emissions in Ontario.

1.3.1 Petroleum transportation fuels

Petroleum products used for transportation are the largest source of energy use and GHG emissions in Ontario. The province does not have any fuel conservation targets for petroleum transportation fuels, or targets to reduce the amount people drive. Transportation fuel efficiency has typically been left to federal vehicle efficiency standards for both light- and heavy-duty vehicles. These generally keep pace with standards in the U.S. to enable uniformity across the North American automotive sector. Current regulations aim to improve the new passenger car fleet to be about 38% more efficient on average in 2025 than it was in 2016.

Currently the U.S. is proposing to freeze its fuel efficiency standards rather than improving them from 2022-2025. If Canada follows suit, it would slow energy efficiency improvements in this sector.

The province does not have any fuel conservation targets for petroleum transportation fuels.

Provincial regulations have led to bio-based diesel and ethanol substituting for a small share of the petroleum-based gasoline and diesel used for transportation. Other provincial impacts on transportation fuel use are more indirect. They include tools like land use planning and investments in alternative modes of transportation

infrastructure. If used properly, these can encourage modal shifts away from inefficient passenger combustion-engine vehicles to mass transit, cycling, walking, and carpooling. However, current government policies are driving fossil fuel use up; see **Chapter 4**.

Since 2004, Ontario has dedicated a portion of its gas tax to municipal transit funding. Through the Growth Plan in 2006, the provincial government began to set density and intensification targets for the Greater Golden Horseshoe area. As well, it began to promote the development of more transit-friendly communities in its Provincial Policy Statement. **Chapter 4** provides a more detailed discussion of land use planning as a tool for transportation fuel conservation.

The province also subsidized electric vehicle (EV) sales from 2010 to 2018, and had an EV adoption target of 5% of new vehicles sales by 2020. EVs are more efficient, using much less energy on average than equivalently sized combustion engine cars (up to 2/3 less). Ontario's current EV policy calls for reducing red tape and enabling the market to increase EV adoption. The ECO has not seen any specific actions the government intends to take to achieve these objectives.

Natural gas is Ontario's second leading source of GHGs.

1.3.2 Natural gas

Next to petroleum transportation fuels, natural gas is Ontario's biggest source of energy. In 2016, natural gas was directly used for about 28% of Ontario's energy needs – primarily space and water heating in houses and other buildings, and as a heat source in manufacturing processes (see Figure 1.4). Natural gas has less potent air quality impacts than gasoline and diesel, but is a fossil fuel and represents Ontario's second leading source of GHGs.

Like electricity, natural gas use in Ontario is affected by building codes and product standards, as well as utility-run conservation programs. Because the first two conservation policies affect multiple fuels, they are discussed separately below.

The most important natural gas efficiency policy in Ontario is ratepayer funded natural gas conservation programs, which have been in place in some form since the 1990s. Reducing natural gas through cost-effective utility-run conservation programs helps program participants save money, with limited impacts on non-participants, and helps the province reduce its carbon footprint. In 2016 natural gas received only one quarter of the conservation program budget of electricity programs, although natural gas conservation represents much greater GHG emissions reductions and much more of the province's energy supply. This differential in budget may be because:

- natural gas has historically been less expensive than electricity (and therefore natural gas conservation is less appealing to customers), and
- natural gas conservation does not help avoid major new costly infrastructure projects to the same degree as electricity conservation.

From 2007 to 2016, conservation programs have reduced natural gas demand in Ontario by about 7% below what it would otherwise be, which is equivalent to about 3 Mt of GHGs (see **Appendix D** for more details). There is much more achievable potential. See **Chapter 2** for a more detailed discussion of opportunities to improve utility-run conservation programs.

Conservation programs have reduced natural gas demand in Ontario by about 7%, which is equivalent to about 3 Mt of GHGs.

1.3.3 Electricity

Electricity use in Ontario has become more efficient due to a combination of market forces, more stringent appliance standards and building codes as well as utility-run conservation programs.

From 2006 to 2017, utility-run electricity conservation programs have resulted in a 7% reduction in electricity use; codes and standards have resulted in a 4.8% reduction.

Since the mid-2000s, electricity distribution companies have provided conservation programs to their customers. From 2006 to 2017, utility-run electricity conservation programs have resulted in a 7% reduction in electricity use.[31]

Over that same time, codes and standards (discussed further on) have resulted in a 4.8% reduction.[32] Electricity is the only fuel in Ontario where the impact of codes and standards and conservation programs are separately tracked (see Figure 1.12).

Because of Ontario's phase out of coal and commitment to renewable energy and conservation, electricity was 96% carbon-free in 2017 and 94% in 2018. As a result, electricity conservation only directly reduces GHG emissions at certain hours of high demand (when natural gas-fired generation is used).

Ontario's low-carbon electricity is a critical step in the province's transition to a low-carbon economy for two key reasons: it is both more efficient and has a significantly lower carbon footprint than Ontario's primary transportation and heating fuels. Electricity conservation is critical to free up space for fuel switching from fossil fuels to electricity, and to limit the province's need for more electricity generation to meet this new source of electricity demand. The ECO's modeling showed that if Ontario is to displace enough fossil fueled energy to meet a stringent 2030 GHG reduction target, then, in addition to expanded conservation, a large amount of electrification (roughly 1/3 of current electricity use) would likely be needed (see Figure 1.13).

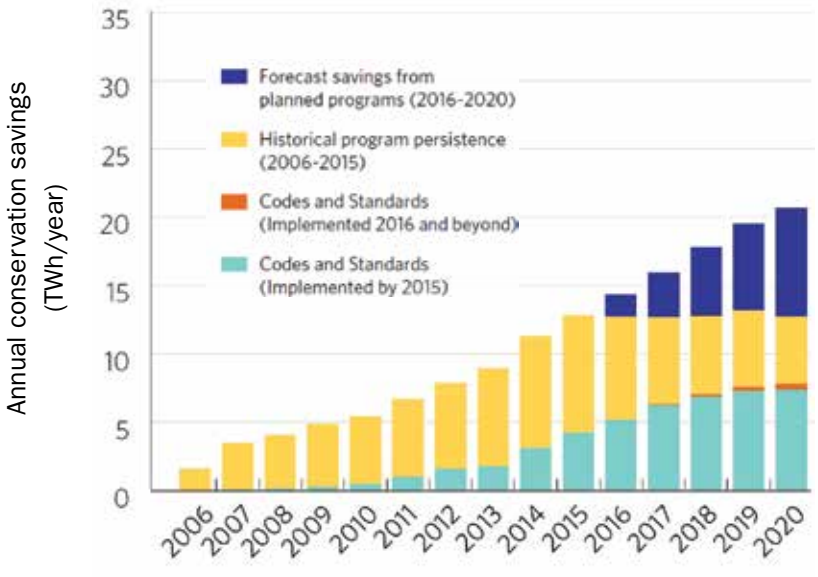


Figure 1.12. Conservation savings due to a combination of conservation programs, building codes and equipment standards.

Source: IESO, Ontario Planning Outlook (2016) at 8.

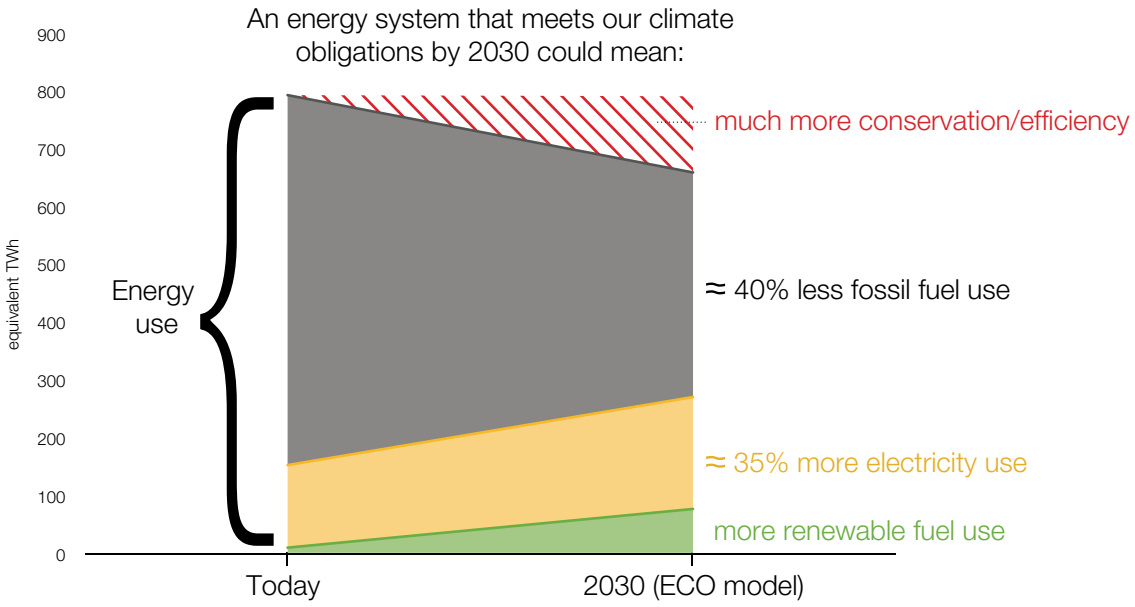


Figure 1.13. Changes in energy use required to meet stringent GHG limits by 2030.

Source: Environmental Commissioner of Ontario, Making Connections: Straight Talk About Electricity in Ontario (2018) at 235.

1.3.4 Other heating and industrial fuels

Roughly 10% of Ontario's energy use is provided by a combination of other fuels used for heating and industrial use, including coke, propane, heating oil, and wood. These other energy sources do not receive any significant conservation support.

Industrial uses of coke, wood and biomass for energy

Certain carbon-heavy forms of fossil fuels like coke and coke oven gas are burned for energy by heavy industry (in some cases, also serving as chemical reactants in the production process). An example is the use of petroleum coke in cement production and refineries. Biomass is also a source of energy for Ontario's pulp and paper or sawmill operations. Opportunities to reduce the use of these fuels (through efficiency improvements or fuel substitution) will be facility-specific. Because these fuel sources are often by-products of the manufacturing process, they have a low cost to industry, reducing the incentive to conserve energy.

Several elements of Ontario's former Climate Change Action Plan attempted to overcome this barrier and encourage energy efficiency or fuel switching among these industries. These initiatives included the carbon price established through cap and trade (both petroleum coke and coke have high carbon emissions per unit of energy production, so a carbon price raises the cost of these fuels). The plan also included the GreenON Industries program and TargetGHG program (both of which provided funding to reduce GHG emissions reductions among large industrial customers). With the cancellation of these initiatives, there are no Ontario policies or programs designed to support industrial facilities in conserving these fuels.

There are no Ontario policies or programs designed to support industrial facilities in conserving these fuels.

Fuels used for heating in remote and rural areas

In parts of Ontario where natural gas is not available (much of rural and northern Ontario), propane, heating oil, and wood are burned for heat. While primarily used to heat buildings, these fuels can serve other applications as well, such as crop drying for agriculture. Ontario residents, farms, and businesses using these fuels have no access to provincial conservation programs (some of the now-cancelled GreenON programs did temporarily expand conservation to users of these other fuels).[33]

A more comprehensive conservation framework in Ontario, discussed in **Chapter 2**, could incorporate conservation programs for these fuels.

1.3.5 Critical multi-fuel conservation tools: the Building Code and appliance standards

Since 1975, Ontario's Building Code has been regulating the use of energy (natural gas, electricity and other fuels) in new buildings. Ontario's Building Code now contains some of the most stringent energy efficiency standards in North America. The previous government indicated the Building Code would gradually trend to net-zero or near net-zero carbon emissions by 2030 but Ontario's draft Environment Plan only mentions supporting "cost effective energy efficiency."

The Building Code's stringent standards leave a huge swath of Ontario's home and building energy savings on the table. Three in four buildings that will be in use in 2030 already existed as of 2017. The Building Code's energy conservation provisions only apply to new buildings or additions; they do not apply to major renovations on older, less efficient buildings. **Chapter 3** discusses the benefits and challenges of expanding the Building Code to this segment of the market.

Another key conservation tool is product-specific energy efficiency standards. As with the Building Code, these are typically designed with significant industry consultation to ensure the standards are technically feasible and economically effective, and yet stringent enough to move the industry benchmark forward and help address gaps in customer awareness. In 1990, the province established a framework to create its own product energy efficiency standards. Today Ontario has 87 product energy-efficiency standards in place, 53 of which are for products the federal government also regulates.[34]

1.3.6 The need for comprehensive targets for reducing fossil fuel use

The province could significantly reduce its bill for importing fossil fuels through energy conservation and fuel switching (see Figure 1.7 for annual spending on fossil fuel imports).

This could be accomplished by setting targets for the reduced use of each fossil fuel. Currently, electricity is the only fuel for which Ontario has a relatively comprehensive target (i.e., one that encompasses more than just utility conservation programs). Ontario has a target for natural gas conservation, but it only encompasses savings from conservation programs, not other initiatives such as codes and standards, and government policies. For other fossil fuels, the government has no conservation targets at all, and should set some – a recommendation that the ECO has made to the government more than once (see **Appendix B** at B.4). To ensure the effectiveness of these targets, the government should track and report on progress towards them.

The ECO recommends that the government of Ontario significantly reduce Ontario's bill for importing fossil fuels through energy conservation and fuel switching.

The ECO recommends that the Ministry of Energy, Northern Development and Mines set targets for reducing our use of each fossil fuel, track and report progress.

1.4 Why government action is needed

Despite the many benefits of conservation, Ontario has a large amount of cost-effective energy efficiency potential that is not being acted on, as shown in section 1.1. Most of the waste is of imported fossil fuels, which have major negative environmental and public health impacts. The inefficient use of low-carbon electricity in Ontario is also important to address, as it is a resource the province could harness to replace fossil-fueled energy uses and avoid the need for costly new electricity generation infrastructure.

Energy technology continues to improve, driven by energy prices, the climate imperative, and government action, among others. But technology, by itself, cannot be counted on to provide the many society-wide benefits of improved energy efficiency. Appropriate government action must address three types of barriers (behavioural, market and systemic) that stand in the way of Ontario developing a much more energy efficient economy. The costs and benefits of conserving energy are misaligned, and the government is uniquely placed to rebalance them. Without government, there is no mechanism to support collective solutions.

Appropriate government action must address barriers that stand in the way of a much more energy efficient economy.

This section examines the most important barriers to energy conservation – behavioural, market and systemic – and shows how smart government action can help address them. These barriers generally correspond with Ontario's three types of energy efficiency potentials: those that are already cost-effective for individuals and businesses but are not being implemented; those that are cost-effective now for society but not yet cost-effective for individuals and businesses because of market failures, and those that are not yet cost-effective because of systemic failures.

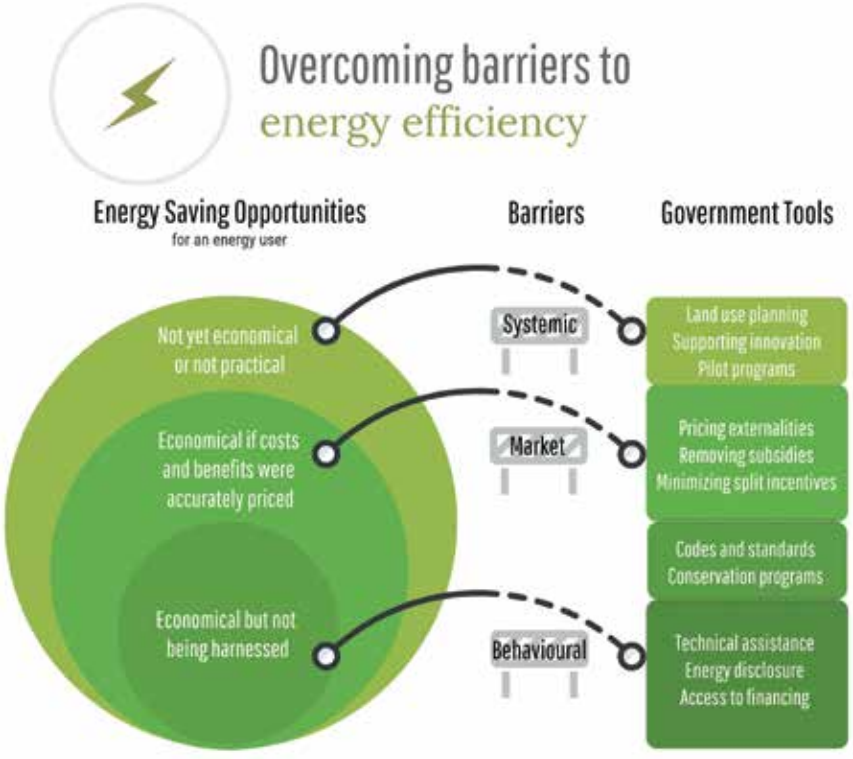


Figure 1.14. Overcoming barriers to energy efficiency.

1.4.1 Behavioural barriers

Behavioural barriers are those that keep an individual or a business from taking energy efficient actions that are within their control and ability and that would benefit their own economic interest. Three of the key behavioural barriers are:

- lack of reliable information
- perceived risk and uncertainty, and
- upfront costs.

Barrier: Lack of information

A primary behavioural barrier to optimizing energy use is lack of reliable information for energy consumers about:

- their current energy use and how it compares to relevant benchmarks
- what they can do about it, and
- how much this would save, in financial, environmental and other benefits.

People and businesses may not have the information or skills to identify the most efficient solutions. A related barrier is the time and effort required. Understanding a home or business's most efficient energy usage is not a simple task. Even deciding on the most energy efficient dishwasher or data server is not easy, let alone optimizing the energy efficiency of a large building or manufacturing process.

Accurate, reliable information can help. One study estimates that informational 'nudges' focused on households could reduce GHG emissions in the United States over 10 years by 7.4% annually without any significant effect on the well-being of the household.[35] But customer confidence can be hampered, rather than helped, when customers receive diverse marketing materials for conservation measures from multiple sources, which is often a weakness of the current utility-based programs.

Solutions:

Governments (whether provincial or municipal) can ensure that individuals and businesses have easy access to reliable, consistent energy efficiency information. Such information can come from educational tools like:

- expert advice;
- public energy-use reporting and benchmarking for buildings;
- energy-use labelling (for products, buildings and homes – the latter is discussed in **Chapter 3**);
- energy audits; and
- other technical and informational assistance (such as support for energy managers).

Ensure easy accesss to reliable, consistent energy efficiency information.

Streamlining the conservation program information that is currently available from both natural gas and electricity utilities, could also help to overcome this barrier (see **Chapter 2**).

Barrier: Risk and uncertainty

Another key behavioural barrier is customer uncertainty about the energy and financial savings that will be achieved from a conservation project, and about whether new products and technology can be trusted to operate safely and reliably. People may feel more comfortable with familiar, inefficient products and technology than with something new, which they may perceive as riskier. People and businesses may also be uncertain as to whom they should trust to do the work.

Make energy conservation solutions as safe and automatic as possible.

Solutions:

Governments can make energy conservation solutions as safe and automatic as possible for individuals and businesses. Confidence can be improved by official certifications, and by codes and standards that make proven conservation solutions routine. **Chapter 3** examines the opportunity to trigger cost-effective energy efficiency improvements of older homes during renovations through amendments of the Building Code.

The unfamiliarity and perceived risk of new products, technologies, or methods can also be dramatically reduced if the government buys them first. Each year the province spends billions buying goods, services, and infrastructure. Since energy efficient measures typically save money over the life cycle of goods, services and infrastructure, and since governments expect to keep operating that whole time, it makes good sense for governments to select investments that will pay back even over long time frames. The province had already begun to incorporate lifecycle cost assessments in some of its infrastructure investments and has advised municipalities to do the same.

The province's draft Environment Plan says the government will "[c]onsider climate change when [purchasing] goods and services", although it adds the condition that the purchases "be cost-effective."[36] "Cost-effectiveness" is not defined. The province should use a lifecycle (i.e., including capital, operational, fuel, maintenance and end of life) costs lens for all government and broader public sector procurements, and ensure that environmental impacts are considered in that analysis.

Barrier: Upfront costs

Energy efficiency measures typically require an upfront investment (e.g., buying a more fuel efficient, more expensive car or furnace) in exchange for savings that accrue over a long period of time (e.g., in buying less fuel). Even when the costs and savings associated with an energy efficiency project are accurately known, and will have a clear positive payback, individuals and businesses are often unable or reluctant to put up the initial cash.

Low participation numbers for residential energy efficiency improvements are partly related to high upfront costs of many energy efficiency upgrades. Customers interested in pursuing these upgrades may be unwilling or unable to pay these costs out-of-pocket.

Solutions:

Upfront costs can be reduced, sometimes to zero, with financing that is secured by the energy savings to be produced. However, access to financing on good terms can also be a barrier (described below).

Conservation incentive programs can reduce the actual payback period of energy efficiency investments, but also have a behavioural component in convincing customers that the decision to favour long-term savings is in their best interests. Making energy efficiency mandatory (i.e., through codes and standards) could also reduce costs (through economies of scale) and eliminate the need for individuals to weigh the short-term costs and longer-term benefits of conservation.

Upfront costs can be reduced with financing secured by the energy savings.

1.4.2 Market barriers

Market barriers are those that discourage an individual or a business from taking energy efficient actions that are within their control and ability and that would be of benefit to Ontario, because doing so would not benefit their direct economic interest. Three of the key market barriers are:

- split incentives
- lack of fair pricing for efficiency compared to other energy sources, and
- high borrowing and transaction costs.

Barrier: Split incentives

Energy bill savings represent the primary financial return on energy efficiency investments. For this reason, one of the clearest market barriers is the split incentive that occurs where those who could conserve energy/invest in energy efficiency do not receive the resulting bill savings.

The split incentive occurs where those who could conserve energy/invest in energy efficiency do not receive the resulting bill savings.

For example: landlord/tenant agreements often provide that only the landlord may alter the building, but only the tenant pays the energy bills. Where individual units are not sub-metered, tenants' individual energy consumption may have little or no impact on their bills. This type of "agency barrier" affects about 9% of overall energy-efficiency potential in the U.S.[37]

Even homeowners may be unwilling to invest in energy efficiency if they expect to move before recouping the full value of an investment. In the U.S., about 40% of homeowners are deterred from investing in conservation projects by the estimated length of their ownership.[38]

At a broader level, there is a split incentive between energy utilities and their customers if the energy savings are worth more to the utility (due to avoiding new energy infrastructure) than to the individual customer who may conserve energy. This has been the primary rationale for utility-run electricity conservation programs.

Solutions:

The government could address these split incentives by:

- allowing landlords to pass through the cost of energy efficiency improvements to tenants, provided that the monthly energy bill savings received by the tenant are greater than this cost
- ensuring that each unit in a multi-unit building has its own energy sub-meter
- helping homeowners who plan to move recoup the value of energy efficiency investments in their selling price, through mandatory energy use labelling
- encouraging on-bill or property tax financing (so that the vendor does not put up the upfront cost and therefore is not disadvantaged by selling the property before the conservation investment is paid off; the savings and the repayment both are transferred to the buyer)
- requiring utilities to pursue conservation when it costs less than energy infrastructure, and
- setting energy prices at levels that reflect marginal system costs.

Barrier: No level playing field

Fossil fuels have an unfair advantage: their price does not reflect their damage to the environment, the climate and public health, and they are heavily subsidized. Because the prices of fossil fuels are artificially low, energy conservation of these fuels (and switching to other fuels) is less financially attractive to customers than it should be.

Many fossil fuel users, including those who heat with oil, receive direct financial subsidies. In our 2015/2016 Energy Conservation Progress report, we indicated that Ontario provides more than half a billion dollars in tax concessions each year to support fossil fuel use.

Natural gas use receives an additional subsidy by forcing ratepayers to subsidize natural gas infrastructure expansion, which locks in long-term fossil-fuel dependence. The government enables Ontario's natural gas companies[39] to spread a portion of the cost of new natural gas infrastructure across all its Ontario consumers, not just the community the infrastructure will serve. Lower carbon heating solutions, such as geothermal, do not receive a similar subsidy. In 2018, the government overruled a decision of the Ontario Energy Board, and forced the board to permit further subsidization by existing ratepayers of natural gas infrastructure expansion into rural areas. This could increase natural gas use and its emissions in Ontario, partly offsetting the proposed 3.2 Mt annual CO_2e reduction in 2030 from natural gas conservation programs in the government's draft Environment Plan (see **Chapter 2**).

The federal carbon pricing backstop has two components that take effect in Ontario in 2019. On its own, the carbon price on fuels (to be applied in April) will capture some, but not all, of the negative environmental and social costs of burning fossil fuels. It will therefore only partly resolve the unfair pricing barrier.

Solutions:

The government can stop subsidizing fossil fuel consumption, and ensure that retail prices of all forms of energy include their full social and environmental costs.

Stop subsidizing fossil fuel consumption.

Barrier: High borrowing and transaction costs

Customers interested in pursuing energy conservation projects may be unable to access financing to cover the upfront costs of a project, or may only be able to do so at rates that make the project uneconomic. This is a problem in both the residential and commercial sectors.

In the residential sector, lending institutions may not recognize that energy efficiency investments should be treated differently than many other types of personal spending that require credit, due to their ability to deliver a future income stream in the form of lower energy bills.

In the commercial/institutional building energy efficiency sector, investments are being hampered by high financing and transaction costs. Energy efficiency projects have comparatively high costs of credit and project evaluation (for the projected energy savings and/or for the credit-worthiness of the building owner), in comparison to the size of the financing required.[40] Most energy efficiency projects are relatively small for the investment world (in the $10,000 - $100,000 range), and conventional lenders may lack the skills to quickly and reliably assess the value of energy efficiency projects. This makes individual, bespoke credit and project evaluations economically inefficient, and therefore unnecessarily expensive.

Improve access to credit on good terms for energy efficiency projects.

Solutions:

In partnership with private sector lenders, the government could support initiatives that improve access to credit on good terms for energy efficiency projects.

If done correctly, Ontario has a major economic growth opportunity by improving financing in the commercial/institutional building energy-efficiency sector. As

described by Canada's Expert Panel on Sustainable Finance,

> In Canada, buildings are a major source of GHG emissions, as our building stock is more energy intensive relative to other countries, including those with similar climates. As a result, there is tremendous opportunity to reduce Canada's footprint by retrofitting our existing building sector. Building retrofitting has the potential to be a winning proposition for all stakeholders, with energy savings for building owners, jobs for the construction industry, and increased lending activity at financial institutions.[41]

Standardized energy efficiency project certification can help lenders understand the value of energy efficiency projects and reduce transaction costs. For example, the Investor Confidence Project certifies energy efficiency projects by assembling existing standards and practices into a consistent and transparent process which increases investor confidence in the projected energy savings.[42]

This barrier could also be reduced with the assistance of specialized intermediate lenders who could act to standardize and aggregate smaller projects, thus reducing transaction costs as well as the perceived risk. To leverage additional capital, they could package groups of projects into scales that large investors (such as pension funds) are accustomed to, and then sell them on. As reported by Canada's Expert Panel on Sustainable Finance, "[m]any commentators suggested that there could be an opportunity to aggregate, warehouse and/or securitize retrofit projects."[43]

One such intermediate lender is a 'green bank', which governments have set up in many jurisdictions, including New York, Massachusetts, Rhode Island, Australia, and Connecticut. Green banks use public dollars to fund loans and/or to backstop private investment in the sector. Eventually, a green bank should make itself obsolete. According to Evergreen, "[a]s private lenders gain experience and information about the processes, risks and addressable market size in clean energy, they can become increasingly comfortable and confident lending into these markets."[44]

The government proposes, in its draft Environment Plan, what might become a version of a green bank: an emissions reduction fund named the Ontario Carbon Trust (this name could change). Little is publicly known of the trust's design, which hopes to leverage some public dollars to harness a much larger amount of private dollars via "innovative financing techniques" and "market development tools" to "speed up the deployment of [commercially viable] low-carbon solutions."[45]

At the residential level, solutions such as on-bill financing and local improvement charges can help provide financing for energy efficiency projects on favourable terms (see **Chapter 3**).

1.4.3 Systemic barriers

Systemic barriers are those that discourage or prevent an individual or a business from taking energy efficient actions that would be of benefit to Ontario, because the province's energy system, infrastructure and/or land use planning make such actions difficult, impractical or impossible. Three of the key systemic barriers are:

- lack of appropriate technology
- lack of appropriate infrastructure, and
- urban sprawl.

Barrier: Lack of appropriate technology

Customers can only buy what is in front of them in the energy marketplace. At the same time, made-in-Ontario energy efficient technologies may be unable to break into the marketplace without government assistance. When appropriate technology is not yet market ready, or has not yet received relevant Ontario approvals, government has a unique role to play in supporting the private sector in research, development, demonstration, and piloting of new technologies.

Support innovation.

Solutions:

According to the Ontario Environment Industry Association, government can support innovation by:

- maintaining supporting agencies that focus on primary innovation (i.e., in new companies), for example Ontario Centres of Excellence, and MaRS;
- supporting research and product development in existing companies, and making sure these programs are truly accessible and available to small- and medium-sized environment and cleantech businesses; and
- helping connect Ontario's traditional companies with companies providing energy efficient solutions (e.g., a database, social media connections, networking events, etc.).[46]

Support for innovation can also be provided by public sector procurement as well as government-funded pilot projects that help prove the viability of energy efficient technologies and create investor confidence. Great examples of the latter include pilot projects funded by the Smart Grid Fund and the IESO's Conservation Fund. The government has a unique role to play to help move local cleantech solutions into economically viable industry players.

The government's draft Environment Plan suggests that the government will support innovation via regulations and policies designed to facilitate and enable the sector.[47] Such support is essential, as the government is counting on "innovation" (i.e., technology that is not yet available) to deliver annual reductions of about 2.2 Mt CO_2e in 2030 as part of the government's pathway to its 2030 GHG reduction target.

Barrier: Lack of appropriate infrastructure

Energy efficient technology may exist and be cost-effective but its adoption by individuals is unlikely if appropriate shared societal infrastructure is not available. For example, electric cars and buses are much more efficient and have less fossil fuel dependence (and also pollute less) than conventional vehicles but their adoption is much less likely if charging infrastructure is not available. Similarly, urban commuters are much less likely to walk or cycle if they do not have infrastructure (e.g., sidewalks, bike lanes) where they can do so safely. Intercity commuters are more likely to take buses when designated lanes allow them to arrive quickly and on time.

Solution:

The government can build infrastructure that makes energy efficient choices safe, easy and comfortable.

Build infrastructure that makes energy efficient choices safe, easy and comfortable.

Barrier: Urban sprawl

Ontario's current built form largely discourages energy efficient transportation because it is spread out, low density, and largely single use (i.e., homes are not close to jobs, shops, or schools, etc.). The various parties that are responsible for building out these systems (e.g., land developers, investment firms, architects and engineers) do not have a mandate to protect the public from the collective environmental and economic impacts of these decisions. Land use planning and existing infrastructure often mean that individuals are limited in their transportation options to private car ownership. See **Chapter 4** for further discussion.

Solutions:

The government can use land use planning tools to facilitate complete communities that integrate multiple uses, at densities that can support transit and limit sprawl.

Use land use planning tools to facilitate complete communities.

1.5 Three key opportunities

The rest of this report looks in more detail at three of Ontario's key opportunities to overcome barriers to become an energy conserving economy, with reduced dependence on fossil fuels.

- **Chapter 2** examines how utility gas and electricity conservation programs can deliver 3.2 Mt CO_2e of annual greenhouse gas emissions reductions by 2030 as part of the government's pathway to its 2030 target in its draft Environment Plan (**Appendices C** and **D** examine the most recently available electricity and natural gas utility conservation program results). Conservation programs can tackle a range of barriers, including lack of information and lack of fair pricing for efficiency compared to other energy sources.
- **Chapter 3** examines opportunities for "deep efficiency" improvements to Ontario's older housing stock, addressing barriers to homeowner retrofits including lack of reliable information, risk and uncertainty, upfront costs, split incentives, and high borrowing and transaction costs.
- **Chapter 4** discusses opportunities to overcome the barriers of urban sprawl and lack of appropriate infrastructure, using smarter land use planning to reduce energy use and kilometres driven in private vehicles, while improving public health.

Endnotes

1. A more precise definition of energy waste is using more energy than the minimum that would be needed to achieve the same outcome at the same (or lower) cost.

2. IESO, Achievable Potential Study: Long Term Analysis by Nexant (25 November 2016) at 43; Ontario Energy Board, Natural Gas Conservation Potential Study by ICF International (7 July 2016) at v. (These potential savings (which could be captured by conservation programs) are on top of savings already expected from other government actions such as codes and standards.)

3.

NRCAN Comprehensive Energy Use database	1990	2007	2016
Passenger transportation (overall energy use, PJ)	417	504	525
Passenger transportation (MJ/Pkm)	**2.21**	**1.91**	**1.82 (-18% from 1990) (-5% from 2007)**
Freight transportation (overall energy use, PJ)	198	301	303
Freight transportation (MJ/T km)	**3.39**	**2.89**	**2.35 (-31% from 1990) (-19% from 2007)**
Residential energy use (overall energy use, PJ)	533	581	552
Residential energy use (GJ/m2)	**1.11**	**0.84**	**0.7 (-37% from 1990) (-17% from 2007)**

4. The sector experienced a tripling of auxiliary equipment energy use over this period. This is likely due to increased data storage.

5. Clean Energy Canada, The Economic Impact of Improved Energy Efficiency in Canada: Employment and Other Economic Outcomes From the Pan-Canadian Framework's Energy Efficiency Measures by Dunsky Energy Consulting (3 April 2018) at 16.

6. Canadian Institute for Energy Training, information provided to the ECO (26 September 2018).

7. Independent Electricity System Operator, 2017 Report on Energy-Efficiency Activities, at 11.

8. Ibid, at 12.

9. Canadian Institute for Energy Training, information provided to the ECO (26 September 2018).

10. McKinsey & Company, Energy efficiency: A compelling global resource (2010) at 2.

11. Net annual crude oil and natural gas import volumes were estimated by adding total annual imports and total annual inter-regional transfers and subtracting total annual export volumes. For crude oil, the net annual import volume was multiplied by an estimate of the value (per unit) at the Ontario border, adding the commodity cost (average of the annual "Canadian Light Sweet" and "Western Canadian Select" commodity prices, assuming roughly a 50/50 share of these two products), plus the transportation costs to Ontario (Nanticoke) via the Enbridge Mainline from Edmonton. For natural gas, the net annual import volume was multiplied by the cost (per unit) at the Ontario border that was assumed to be the average annual spot price at the Dawn Hub, as this reflects both the commodity cost and the cost of bringing the product to the Ontario border. The net annual import costs of refined petroleum products was taken directly from Statistics Canada. Some portion of the fossil fuel imports shown here will be used for non-energy uses (e.g., petrochemicals). Other fossil fuels such as natural gas liquids and coal and coke are not included in this figure.

12. The Canadian government is currently working on developing a database.

13. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan, Draft (Queen's Printer for Ontario, 2018) at 36.

14. Rob McMonagle, Discussion Paper: Stimulating the Growth of Toronto's Green Sector (Toronto: City of Toronto, 24 September 2018) at 1.

15. Glen Hodgson, economist and Senior Fellow at the Conference Board of Canada, "It's time to think globally about green business opportunities, and to bring green trade fully into the trade policy agenda." (Policy Options, 22 August 2017).

16. Zion Market Research, "Global Smart Thermostats Market Is Set For A Rapid Growth And Is Expected To Research Around USD 7.904.4 Million by 2024" online: <www.zionmarketresearch.com/news/smart-thermostat-market> [Accessed 15 February 2019].

17. Joe Greenwood and Farooq Qaiser, Innovation in Cleantech: How Canada can become a global leader (Toronto: MaRS, March 2017) at 7.

18. Environmental Commissioner of Ontario, 2015/2016 Energy Conservation Progress report, Conservation: Let's Get Serious (Toronto: ECO, 2016) at 74.

19. Some relatively minor renewable energy sources not captured in this 25% for which accurate data do not exist include solar energy used for hot water heating and renewables used for off-grid electricity production.

20. International Energy Agency, Market Report Series: Energy Efficiency 2018 (OECD/IEA, 2018) at 13.

21. Clean Energy Canada, The Economic Impact of Improved Energy Efficiency in Canada: Employment and Other Economic Outcomes From the Pan-Canadian Framework's Energy Efficiency Measures by Dunsky Energy Consulting (3 April 2018) at III.

22. Based on current emissions. (Lisa DeMarco, "Ontario Energy Association Speaker's Series, Ontario's Climate Change Plan" (presentation, 11 December 2018) slide 3, online: <documentcloud.adobe.com/link/track?uri=urn%3Aaaid%3Ascds%3AUS%3A18845028-a5c3-43e7-a95a-96ee9dc8dcb9>. Under the assumptions, the previous target would have been 114 MT in 2030, whereas the new target is 143 MT in 2030 {Ontario emissions in 2016 were 161 MT, and emissions in 2018 are expected to also be around 161 MT}.)

23. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan, Draft (Queen's Printer for Ontario, 2018) at 23.

24. World Health Organization, Health & Climate Change, COP24 Special Report (2018) at 8.

25. Ontario Ministry of the Environment and Climate Change, Air Quality in Ontario 2015 Report (Queen's Printer for Ontario, 2017) at 19. (Note that the reduction in mercury emissions is from a starting year of 2000, whereas the starting year is 1990 for the other two pollutants.)

26. Ontario Ministry of the Environment and Climate Change, Air Quality in Ontario 2016 Report (Queen's Printer for Ontario, 2018) at 7.

27. Toronto Public Health, Path to Healthier Air: Toronto Air Pollution Burden of Illness Update (April 2014) at 2.

28. Statistics Canada, Table 11-10-0232-01 Low income measure (LIM) thresholds by income source and household size.

29. Peak demand savings include savings from conservation programs (1,762 MW), codes and standards (891 MW) and pricing policies (1,495 MW). Demand response could deliver an additional 640 MW of peak demand reduction if activated. Not included in these numbers are 283 MW of "other influenced conservation". (Independent Electricity System Operator, information provided to the ECO (15 January 2019).)

30. For a more detailed discussion of the many environmental impacts of electricity generation infrastructure, see chapter 10 of our 2018 Energy Conservation Progress report, Making Connections: Straight Talk about Electricity in Ontario. For a more detailed discussion of the negative environmental impacts of burning fossil fuels, see chapter 1 of our 2018 Greenhouse Gas Progress report, Climate Action in Ontario: What's Next.

31. Information provided by the Independent Electricity System Operator, 15 January 2019.

32. Ibid.

33. Relevant GreenON programs included the expansion of residential programs for heat pumps and retrofits to customers not on natural gas, the wood heating pilot, and the agriculture program.

34. Ontario Ministry of Energy, Northern Development and Mines, information provided to the ECO (January 2019).

35. Thomas Dietza et al, "Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions" (2009) 106:44 PNAS at 18452. (Because of Ontario's lower-carbon electricity system, the GHG reductions would likely be lower here, but informational nudges could still result in significant GHG reductions as most of Ontario's home energy use is natural gas.)

36. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan, Draft (Queen's Printer for Ontario, 2018) at 35

37. McKinsey & Company, Energy Efficiency: A compelling global resource (2010) at 12.

38. Ibid, at 13.

39. As of January 1, 2019, Union Gas and Enbridge have merged. EPCOR (previously NRG) is the only other rate-regulated natural gas distributor in Ontario, but represents less than 0.1% of the market based on total assets. (Ontario Energy Board, 2017 Yearbook of Natural Gas Distributors, 2018) at 3.

40. For more information, see The Atmospheric Fund's report Money on the Table: Why investors miss out on the energy efficiency market (Toronto: TAF, November 2017).

41. The Expert Panel on Sustainable Finance: Executive Summary (Gatineau: Environment and Climate Change Canada, 2018) at 4.

42. "Investor Confidence Project", online: <www.eeperformance.org/>. [Accessed 05 March 2019]

43. The Expert Panel on Sustainable Finance: Executive Summary (Gatineau: Environment and Climate Change Canada, 2018) at 4. Other governments are also working with the financial sector and businesses to accelerate the growth of sustainable finance, for example:
    - The European Union's High-Level Expert Group on Sustainable Finance released recommendations to create a financial system that supports sustainable investments.
    - The United Kingdom's Green Finance Taskforce brought together finance-sector leaders to work with industry to develop recommendations to accelerate the growth of green finance.

44. Jeff Schub and Geoff Cape, Green Bank Financing to Accelerate Clean Energy Deployment in Canada through the Canadian Infrastructure Bank (Coalition for Green Capital and Evergreen, 2017) at 17.

45. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan, Draft (Queen's Printer for Ontario, 2018) at 27.

46. Ontario Environment Industry Association, Still Ready to Grow: Generating growth and jobs through Ontario's environment and cleantech sector (ONEIA, 2011) at 12-13.

47. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan, Draft (Queen's Printer for Ontario, 2018) at 18.

2. Making utility conservation more effective

Abstract

After transportation fuels, natural gas and electricity are the second and third largest of Ontario's energy sources. Natural gas, a fossil fuel, is Ontario's second largest source of climate pollution. Electricity is the smallest and cleanest of Ontario's major energy sources.

Conservation of both of these forms of energy can have significant financial, climate and well-being benefits; natural gas conservation has larger climate and air pollution benefits.

For close to a decade, Ontario's electricity and gas utilities have successfully delivered valuable conservation programs for their respective forms of energy, paid for through customers' bills. The government has created uncertainty about continued funding for electricity conservation, but projects that as part of the government's pathway to its 2030 target in the draft Environment Plan, expansion of the utilities' natural gas conservation programs will reduce Ontario's annual greenhouse gas emissions by 3.2 megatonnes of carbon dioxide equivalent (Mt CO_2e) by 2030.

This chapter summarizes the financial, climate and well-being benefits of Ontario's utility conservation programs, and examines the changes needed to achieve a 3.2 Mt CO_2e emission reduction at the least cost. Expanding natural gas conservation is important but cancelling electricity conservation would offset most of its potential benefits. The air and climate pollution benefits of electricity conservation can be improved by focusing on reducing electricity use at times of high demand, when fossil-fuelled electricity generators are running. Conservation of other space heating fossil fuels, such as propane and oil, and switching between energy sources, may help reduce the cost of the 3.2 Mt CO_2e emission reduction.

Ontario's post-2020 conservation framework should consider whether a single administrator model would more efficiently deliver conservation programs for all these energy sources.

Contents

2.1 Introduction

Ontario has recognized that energy conservation is the least costly energy resource for the province. Over the past decade, conservation of natural gas and electricity has helped customers save money on their utility bills, reduced pressure on existing assets, delayed the need for new expensive infrastructure and made living conditions more comfortable for vulnerable customers. In Ontario, energy conservation programs have been designed and delivered mainly by the province's electric local distribution companies (LDCs) (for electricity) and gas utilities (for natural gas).

Energy conservation is the least costly energy resource.

The Ontario Energy Board (OEB) sets the rates and rules for both the natural gas and electricity sectors. The OEB also oversees the natural gas demand-side management (DSM) framework. On the other hand, the delivery of electricity conservation programs is overseen by the Independent Electricity System Operator (IESO). In addition to programs delivered to distribution-connected customers by the LDCs and the IESO, the IESO also delivers conservation programs directly to large customers connected to the transmission system.[1] In all cases, the utilities' customers pay for the conservation program through charges on their respective energy bills.[2] Utility conservation programs have been around consistently for just over a decade for electricity and over two decades for natural gas.[3] Both the LDCs and the gas companies have performed well in achieving significant reductions in electricity and gas use, as detailed in **Appendices C** and **D** of this report (available online).

Ontario should develop a new framework that will make utility conservation more effective.

With the current electricity and natural gas conservation frameworks running out in 2020, Ontario should develop a new framework that will make utility conservation more effective, i.e., how it can continue helping customers save money and improve their well-being while achieving the government's goal of 3.2 megatonnes of carbon dioxide equivalent (Mt CO_2e) of GHG emissions reduction by 2030.

2.2. Natural gas and electricity conservation frameworks

2.2.1 Current conservation programs

Both the electricity and gas utilities are currently over halfway through their respective conservation frameworks that were set for 2015-2020. A range of programs are offered to the main sectors: residential, commercial, industrial and low-income customers. Residential programs range from rebates for energy efficient products sold by retailers to replacing the heating/cooling systems in homes to deep energy retrofits of a home. Commercial and industrial programs under both frameworks range from paying incentives to offering technical support to make businesses and industrial facilities more energy efficient. Initiatives include monitoring and evaluating current energy use and paying for some of the cost of upgrading to more energy efficient equipment. Some programs offer staff training and technical assistance to manage and improve energy use. There are also programs that promote leading-edge equipment and processes that are above and beyond the current market practices to facilitate "market transformation". Both frameworks also offer separate programs for the more vulnerable residents of the province living in single-family homes and multi-unit residential buildings to improve their living conditions and reduce energy use.

There are also opportunities for the LDCs and gas utilities to apply for new programs and pilots. These opportunities, especially on the electricity side, allow LDCs to test the cost-effectiveness and market for a new measure or technology. Under the current frameworks, there have been several local programs and pilots successfully launched that have highlighted LDC innovation and market transformation. Section C.2.3 in **Appendix C** (available online) highlights those programs.

Table 2.1 details the key elements of the Conservation First Framework for electricity and the Demand-Side Management Framework for natural gas.

Table 2.1. Key elements of electricity and natural gas utility conservation frameworks.

Key elements	Conservation First Framework (CFF) for electricity	Demand-side Management (DSM) Framework for natural gas
Duration	January 1 2015-December 31 2020	January 1 2015-December 31 2020
Oversight	Independent Electricity System Operator	Ontario Energy Board
Target	7.4 TWh of persistent energy savings to 2020	Gas targets are set annually based on previous year's results and allocated budget
Budget (averaged over the course of the entire framework)	$400 million[4] for LDC conservation programs and $46 million[5] for the IESO's transmission-connected conservation programs (both per year) roughly 2% of the cost of the province's electricity system[6]	$117 million per year, roughly 2% of the cost of the province's natural gas system[7]
Funding	Funded through the Electricity Charges portion of the bill, based on conservation spending for all customers (approximately 2.5% of the total Global Adjustment[8])	Funded through gas distribution rates, based on conservation spending for that class of customers (e.g., $2/month per residential customer account[9])
Performance metrics[10]	Persistent energy savings	Cumulative energy savings
Eligible incentives for utilities	Eligible for a Mid-term Incentive, Achieving Target Incentive and Exceeding Target Incentive. Joint plan with other LDCs means higher incentive. Also eligible for cost-efficiency incentives. Alternatively, can pursue pay for performance funding[11]	Eligible for scaled incentives based on performance against targets. Natural gas utilities need to achieve 150% of their targets to maximize incentives. Annual incentives are capped at $10.45 million each for Union and Enbridge.[12]
Penalties	Range of remedial actions available to the IESO, including financial remedies[13]	Program delivery is voluntary; the OEB does not have any penalties if gas companies miss their targets
Mid-Term Review	Completed by the IESO and presented to Minister of Energy on June 1, 2018 (the IESO advice is not in public domain)	The completed report was posted on the OEB's website in November 2018

Source: 2015-2020 IESO-LDC Energy Conservation Agreement (2014), various Directives and Directions from the Ontario Minister of Energy to the IESO, OPA and OEB from 2014 to present; "Conservation Delivery and Tools", online: Independent Electricity System Operator www.ieso.ca/en/Sector-Participants/Conservation-Delivery-and-Tools/LDC-Toolkit. [Accessed 13 February 2019]; Ontario Energy Board, EB-2014-0134, Report of the Board: Demand-side Management Framework for Natural Gas Distributors (2015-2020), (Toronto: OEB, December 2014).

2.2.2 The benefits of conservation

Both the electricity and the natural gas industries have successfully designed and delivered energy conservation programs to Ontarians, and have been instrumental in fostering a culture of conservation in the province. Conservation programs delivered by Ontario's gas and electricity utilities and the IESO have saved ratepayers and the province money, have helped reduce the province's GHG emissions and have made homes more liveable and businesses more competitive by making them more energy efficient.

Both the electricity and the natural gas industries have successfully designed and delivered energy conservation programs to Ontarians.

Energy use benefits

Electricity conservation was introduced in Ontario in the early to mid-2000s when the province was facing a threat of inadequate power supply and poor reliability. Public appeals to conserve, especially during the hottest days of the year, were not uncommon.[14] The primary goal of conservation was to reduce system-wide peak demand on these hot days. While reliability was the initial driver for Ontario to invest in electricity conservation, there have been additional financial, system, and environmental benefits for customers and for the province as well.

Since 2006, ratepayer-funded electricity conservation programs have reduced annual electricity consumption by around 9 TWh at the generator level, as presented in Figure 2.1.[15] This is enough electricity to power close to a million homes.[16] Without these conservation programs, electricity use in the province would have been almost 7% higher than what was recorded in 2017.[17]

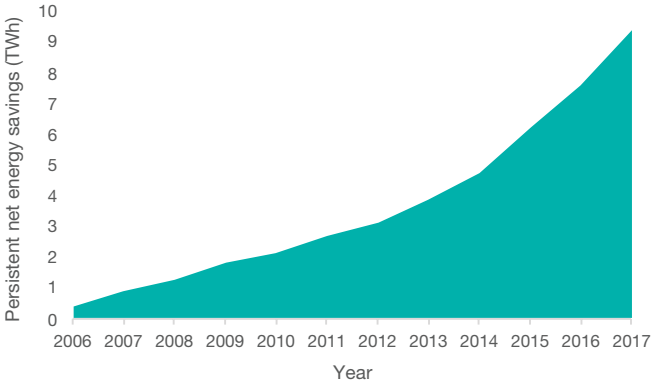


Figure 2.1. 2017 persistent net energy savings from electricity conservation programs 2006-2017.

Note: this does not include savings from codes and standards and non-IESO conservation.[18]

Source: Independent Electricity System Operator, information provided to the ECO (15 January 2019).

As mentioned earlier, electricity conservation has helped shave the province's peak demand, which is by far the most expensive power to provide. Without utility conservation, peak demand would have been roughly 10% higher in 2017 than it actually was. Figure 2.2 presents the 2017 persistent net peak demand savings from 2006 to 2017 from ratepayer-funded electricity conservation programs. Given the fact that in Ontario, electricity demand during peak hours is usually met by increasing gas-fired generation, shaving off peak demand has also had environmental benefits for the province in the form of lower GHG emissions.

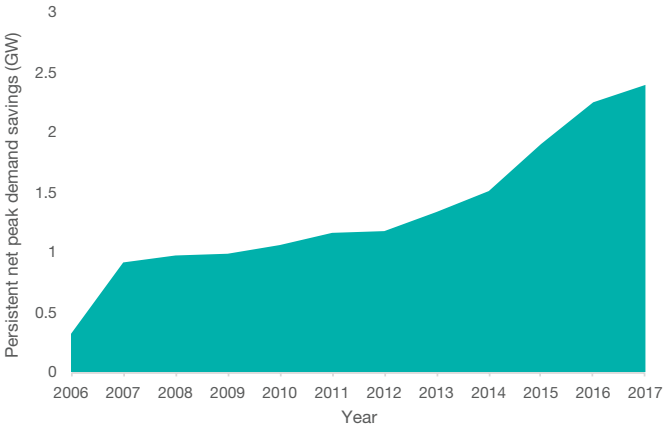


Figure 2.2. 2017 persistent net peak demand savings 2006-2017.

Note: does not include codes and standards, pricing policies and other influenced conservation.[19]

Source: Independent Electricity System Operator, information provided to the ECO (15 January 2019).

Natural gas supplies about 28% of Ontario's energy needs. Reducing natural gas use through conservation reduces customer bills, reduces pressure on the infrastructure (although to a lesser degree than for electricity conservation), acts as a resiliency resource and most importantly, reduces GHG emissions. In 2016, natural gas use was roughly 8% lower for Union Gas customers and 6% lower for Enbridge customers than it would have been without DSM programs, based on conservation results from 2007 onwards.[20] Figure 2.3 presents an estimate of persistent gas savings to date. Since 2007, natural gas conservation programs have reduced annual natural gas consumption by close to 1,700 million m^3. This is enough natural gas to fuel over 700,000 homes.[21]

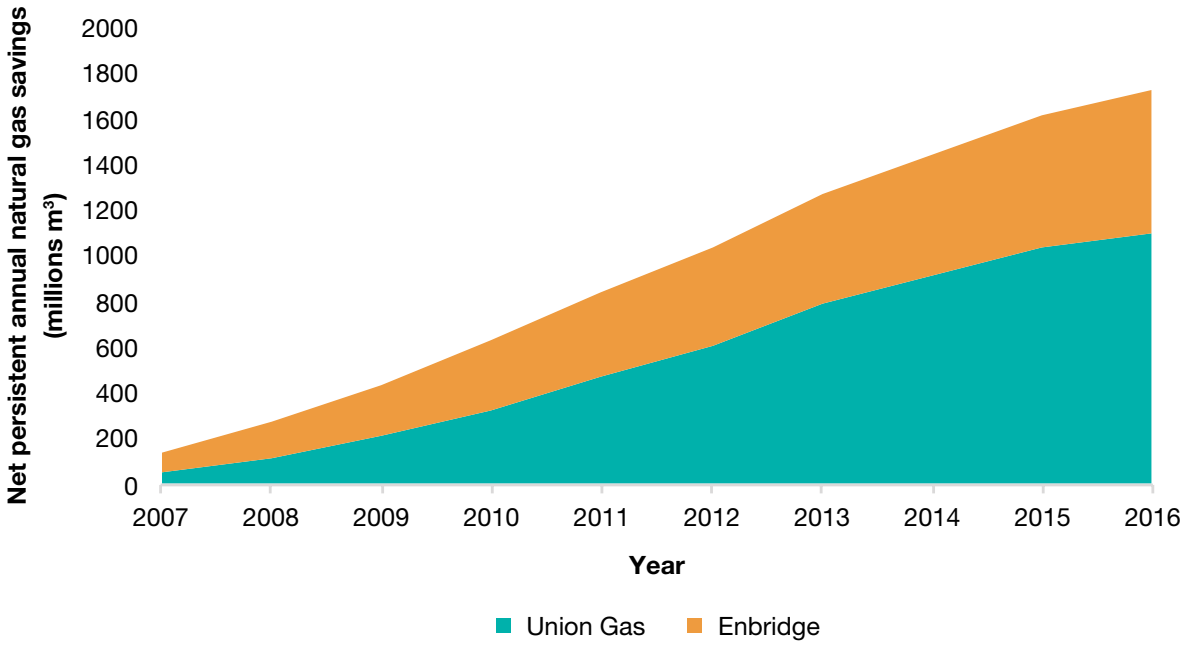


Figure 2.3. Persistent net energy savings from natural gas conservation programs 2007-2016.

Source: Enbridge Gas Distribution Inc., 2016 Demand Side Management Annual Report; Union Gas, 2016 Demand Side Management Final Annual Report.

Overall economic benefits

In order to ensure that utility conservation is adding value to society and to the energy system and its customers, most utility conservation programs must pass cost-benefit tests before they are delivered. In Ontario, energy conservation programs are primarily assessed using the Total Resource Cost (TRC) test. This test quite accurately measures the financial costs and benefits of conservation and its impact on the energy system, but does a less complete job of measuring non-energy benefits, such as improved customer comfort and reduced greenhouse gas emissions. Therefore, both conservation frameworks use a 15% adder to the TRC test to account for non-energy benefits, including GHG emissions.[22] Later in this chapter, we discuss improvements to cost-effectiveness testing to more accurately quantify the emissions reductions from conservation, value these reductions, and prioritize programs that can deliver emissions reductions.

To date, both natural gas and electricity programs have performed well in terms of cost-effectiveness. In 2017, LDC-delivered programs had a TRC of 2.54.[23] This means that for every dollar spent on electricity conservation, there was a benefit of $2.54 to society as a whole.[24] For natural gas conservation, 2016

2

For every dollar spent on electricity conservation, there was a benefit of $2.54.

verified results have shown than Enbridge and Union programs have TRCs of 2.6 and 2.9 respectively, a benefit of close to $3 to society for every $1 spent on natural gas conservation.[25] Therefore, utility conservation continues to be beneficial to Ontario as a whole.

Energy system benefits

Most of the benefits from conservation captured in the TRC test (described above) are from reduced costs in building, fuelling, and operating the electricity and natural gas systems.

There are short-term and long-term benefits to the electricity grid from conservation. In the short term, conservation reduces the use of existing electricity assets, especially during peak hours, when gas-fired generators need to come online and there is also increased pressure on transmission and distribution assets. The province saves on operational and fuel costs and sees less stress on existing assets because of conservation.

Since conservation efforts put in place now will save electricity over multiple years, they may postpone or nullify the need for capital investments in new generation, transmission and distribution assets. The textbox "Using conservation and demand response to postpone/avoid new infrastructure spending" on regional conservation details an example of LDC-led conservation and demand response to postpone new asset construction. With the IESO projecting that the province may be facing a supply shortage by as early as 2023, this long-term benefit of conservation can be crucial in ensuring that the province does not run into reliability issues and face expensive infrastructure spending.

Using conservation and demand response to postpone/avoid new infrastructure spending

Toronto Hydro is currently piloting a rate-funded conservation/demand response (DR) program that is expected to contract close to 12 MW of demand response by its completion in mid-2019.[26] In its current application, the LDC is asking for another $4.6 million over 4 years for more local demand response programs that would defer distribution infrastructure as part of its Station Expansions Program.[27] These investments include installing battery storage and implementing targeted DR programs to reduce peak demand by 10 MW and defer an estimated $135 million of expansion investments in two transformer stations for 5 to 6 years.[28] These investments will allow Toronto Hydro to address capacity constraints with local DR, maintain and enhance reliability of power, expand the planning toolbox to non-wires solutions and allow for more flexibility in future asset planning. Both transformer stations are expected to reach 85% capacity by early 2022 and therefore local DR can help maintain reliability in the short to medium-term while more long-term capital-intensive plans are developed.[29] One of the main reasons Toronto Hydro is proposing local conservation and DR is because the cost is significantly less than building new assets and therefore will have a lower impact on the customer's bills.

The LDC also proposed a conservation alternative to provide capacity relief for a transmission corridor between 2018 and 2021, advising that the incremental conservation would cost between $7-8 million and would defer the transmission need by 5 years.[30]

The OEB is expected to render a decision on the application in the second half of 2019.

For natural gas conservation, the primary economic benefit is reduced spending on commodity natural gas, which is almost entirely imported from outside Ontario. The benefits from gas conservation in avoiding infrastructure spending are not as large as in electricity. There is no direct equivalent in the natural gas system to the electricity conservation benefit of avoiding the need to build new electricity generating stations.[31] There is some benefit in reducing the infrastructure cost to deliver natural gas to customers, but this is only beginning to be quantified, and is discussed later in the chapter (textbox "Gas conservation and infrastructure planning").

Customer benefits

One of the primary benefits to customers participating in energy conservation programs is of course lower energy bills, from making homes, businesses and industries more energy efficient. In addition, conservation can offer valuable co-benefits for some participants.

One of the primary benefits to customers is lower energy bills.

Conservation programs geared towards more vulnerable customers such as low-income communities and Indigenous residents are often delivered at no cost to the customer and deliver a range of other benefits beyond simple bill savings. Programs help reduce energy bills, make living conditions more comfortable (especially for electrically heated homes) and help with better bill arrears management. The textbox "Customer experience with utility conservation programs" highlights two examples of customers from different sectors who have benefitted from utility conservation programs.

Customer experience with utility conservation programs

Lake Shore Gold Mine's experience with the Industrial Accelerator Program[32]

Lake Shore Gold (LSG) is a Canadian based gold producer (a division of Tahoe Canada) with operations based in Timmins, Ontario. The company currently operates two underground mines in Timmins West and Bell Creek, along with an ore-processing mill at Bell Creek. The Bell Creek mill is a conventional gold mill circuit, involving crushing, grinding, gravity and leaching, followed by gold recovery processes. The mill relies on ore from both the Timmins West site, and the Bell Creek underground operation. The company currently employs 650 employees. The two facilities have a combined annual electricity capacity of 27 MW and annual electricity consumption of 181,000 MWh.

Lake Shore Gold is eligible for Ontario's electricity conservation program for large transmission-connected customers, the Industrial Accelerator Program (IAP). According to Lake Shore Gold, the application process to participate in the IAP was straightforward and made easier because of support from an IESO account representative. Since April 2017, the company has been an active participant in several initiatives under the IAP. LSG has completed five design engineering studies with one progressing to a Small Capital Project, where LSG replaced six 30-year old compressors with three more energy-efficient ones at the Bell Creek mine site. The new compressors are expected to save the company 1300 MWh of electricity annually. The company is looking to start another small capital project to upgrade underground ventilation in Q2 of 2019. Lake Shore Gold recently completed a second successful year of the Energy Manager Incentive Program and all lighting in both the mines and the mills has also been changed to energy-

efficient LEDs under the IAP's Retrofit initiative. LSG has seen electricity savings and increased productivity from participating in the IAP. Its ore-processing throughput has improved by over 20%, while the electricity cost associated with processing has reduced by 20%. Participation in the IAP and other energy management programs has helped LSG reduce its electricity use by 8500 MWh in 2018.

A semi- autogenous grinding (SAG) mill at LSG's ore-processing mill, one of the most-energy intensive equipment at that site.

Photo credit: Lake Shore Gold.

Nipissing First Nation Home Weatherization program

In 2017, Nipissing First Nations (population: about 1,450) worked with Union Gas and Hydro One to improve home energy efficiency for its residents with poor home insulation. This ratepayer-funded program provided and installed home weatherization measures (e.g., additional wall/basement/attic insulation, window repairs, low flow shower heads and faucet aerators, and water tank insulation), as well as some non-energy related safety measures (e.g., carbon monoxide and smoke alarms, minor mold remediation, and ventilation improvements), at no cost to participants.[33]

Nipissing is located in Northern Ontario, about 40 km west of North Bay on the shore of Lake Nipissing, where residents face frigid winters. Heating costs are a major burden for residents in the community, many of which are low-income seniors and elders, living in older inefficient homes needing repairs.[34] Despite the fact that these weatherizing measures are very cost-effective, access to capital is a major issue for many residents, making these residents excellent candidates for free energy efficiency upgrades to their home envelopes. Such upgrades normally save about 15% of heating costs on typical housing stock, but can achieve much higher savings in less efficient homes. The community has already reported that homeowners have "seen a significant cost savings which they are able to apply [..] where it is much more needed."[35]

Homeowners have seen a significant cost savings which they are able to apply where it is much more needed.

This type of utility/First Nation collaboration is increasing in Ontario, for example recent electricity conservation projects were completed in Fort Albany, Kaschechwan and Attawapiskat on over 90 homes. By 2020, Union Gas plans to provide its Home Weatherization Program to all its on-reserve customers.[36]

Natural gas conservation has a larger impact on reducing GHG emissions.

Greenhouse gas reduction benefits

While both electricity and natural gas conservation reduce energy use, natural gas conservation has a larger impact on reducing GHG emissions since Ontario's electricity system mostly runs on clean generation (approximately 94% clean generation in 2018[37]). For every cubic metre of natural gas that is not used thanks to conservation, there is an associated reduction in GHG emissions. Natural gas combustion primarily releases carbon dioxide along with minor amounts of methane and nitrous oxide. Natural gas conservation from 2007 to 2016 has reduced Ontario's annual greenhouse gas emissions by roughly 3.3 Mt (approximately 2% of Ontario's annual emissions), as shown in table 2.2.

Table 2.2. Greenhouse gas emissions reductions (Mt CO_2e) from persistent gas utility conservation programs (2007-2016)

	GHG savings from persistent natural gas savings (2007-2016)
Enbridge emissions reductions	1.18 Mt
Union Gas emissions reductions	2.09 Mt
Total	3.28 Mt
Ontario total emissions in 2016 (rounded)	161 Mt
Emissions reductions from natural gas conservation as % of total Ontario emissions in 2016	2.04%

Note: Does not include reductions in upstream emissions.

Source: ECO calculation based on combining first-year net natural gas savings from conservation programs between 2007 and 2016, as reported by Enbridge and Union Gas, and assuming persistence of these savings in 2016.[38]

Electricity consumption leads to GHG emissions mostly during hours of the day when electricity demand is the highest (summer and winter weekdays) since GHG-emitting gas-fired generators are turned on to meet this higher demand. So not only does electricity conservation help in saving operational and fuel costs, it also helps reduce GHG emissions. IESO data has shown that in 2017, there was the potential to directly or indirectly reduce the use of gas-fired generation, i.e., reduce GHG emissions, in approximately 17-42% of the hours in a year.[39] Natural gas-fired generation is projected to run more frequently in future years, as discussed later in this chapter, so the longer-term GHG reduction potential of electricity conservation is higher.

Estimating the historical GHG emissions reductions from electricity conservation programs over the past decade is tricky as it relies on a number of assumptions as to what generation resources would have been used to produce electricity if conservation had not taken place. The ECO has previously looked at this and estimated that the combined impact of conservation programs, codes and standards, and renewable generation reduced electricity sector operational emissions in 2015 by 3-10 Mt CO_2e, depending on the assumptions used.[40] Taking the midpoint of this estimate (6.5 Mt CO_2e), and updating for program activity through 2017, the impact of electricity conservation programs alone was roughly a 2.6 Mt CO_2e emissions reduction in 2017.[41] While this is almost as large as the emissions reductions achieved from natural gas conservation programs, spending on electricity conservation has been much higher.

The future greenhouse gas reduction potentials of both electricity and natural gas conservation are examined in more detail later in this chapter.

Utility conservation also has other benefits such as cleaner air, better health and economic growth, which were discussed in **Chapter 1** of this report.

2.3. Current uncertainty

With a new government elected in 2018 that emphasizes the importance of cutting costs, electricity rates and taxes, there has been a high level of uncertainty about the future of utility conservation. Specifically, spending on electricity conservation programs has been considered by some to be an unnecessary charge on already high electric bills and creating more waste during hours of electricity surplus. We now look at what the current government's latest announcements are for the electricity and natural gas conservation frameworks.

2.3.1 Mid-term reviews

Mid-term reviews for both the electricity and natural gas conservation frameworks (initiated prior to the change in government) were completed in 2018. These reviews were expected to guide conservation policy through the end of the current framework (2020). For natural gas, the OEB completed this review in November 29, 2018, making only minor changes to the current framework (some of which are discussed later in this chapter). The OEB also indicated that the development of the next framework (post-2020) will commence in early 2019, where more substantive changes (e.g., budget expansions, amortization of DSM costs) to the framework could be considered.[42]

For electricity, the IESO completed its work on the mid-term review in spring 2018, and submitted an advice report to the Ministry of Energy, Northern Development and Mines (MENDM) with its recommendations. MENDM has not acted on this report yet, due to a change in policy priorities, discussed below. As a consequence, no changes have yet been made to the electricity conservation framework based on the mid-term review.

The IESO's draft advice report on the Electricity Conservation Mid-Term Review

The Independent Electricity System Operator (IESO) completed and filed a draft mid-term review report on the framework for electricity conservation programs (the Conservation First Framework (CFF)) on June 1, 2018, including recommendations, with what is now the Ministry of Energy, Northern Development and Mines (MENDM). Since this report was filed, Ontario has seen a change in government. It is important to note that the report was in draft state when filed, and MENDM has indicated that certain aspects of the report are now out of date and therefore not relevant to the government's current priorities, which include lowering electricity costs for Ontarians by 12%.[43]

MENDM provided the ECO with a confidential copy of the IESO's draft advice report.[44] Several recommendations made in the IESO's draft advice report align with the opportunities discussed in this chapter. Given its draft and confidential nature, the ECO is providing only a high-level summary of some of the pertinent aspects of the IESO's draft advice report.

Operation of the 2015-2020 Conservation First Framework: The report generally finds that the CFF is performing well to date, and makes relatively minor recommendations for adjustments to electricity conservation program operations within the existing framework. Two outstanding issues include how to ensure availability of conservation programs in all parts of the province, and what to do in areas where local distribution companies (LDCs) may exceed their budgets (often due to better than expected customer participation) before 2020. The report makes some recommendations regarding target and budget exchange, and centralized delivery of province-wide residential programs, to address these issues.

Improving the customer experience: The report flags that customers continue to be confused by a variety of conservation programs offered by multiple organizations and that there is a need for a "one-window approach" to conservation. The report notes the IESO's efforts in this area, including work on a multi-fuel collaboration guideline that will include principles on attribution of costs and benefits and best practices from other jurisdictions, and a mechanism to fund multi-fuel pilots and programs that are joint initiatives between the natural gas companies and the LDCs and/or other partners.

Customers continue to be confused by a variety of conservation programs offered by multiple organizations.

Updating cost-effectiveness calculations: The report recommends that the current 15% non-energy benefits adder used in program cost-effectiveness testing should be revised to separately value the cost of carbon from other non-energy benefits such as comfort. The report recommends that a 13% adder should be used for non-energy, non-carbon benefits, and that the avoided cost assumptions used to calculate the benefits of conservation initiatives should be updated to reflect current electricity system conditions and to include an explicit price on carbon.

Post-2020 conservation framework: All stakeholders who were part of the mid-term review process emphasized the importance of conservation continuing post-2020. The report recommends that larger projects that can take multiple years to bring projects into service should receive certainty of funding during the transition, but all other programs should be closed within the 2015-2020 framework to minimize administrative costs, and make a clean transition to a new framework.

In terms of the next framework, the report recommends that research and consultation on program design and governance should begin now, and that an improved governance model be in place by early 2020 that has been vetted through broader public and stakeholder consultations.

Before developing the next framework, the report recommends an independent third-party review to look at governance, and identify potential entities that could design, deliver and manage energy efficiency programs in Ontario, taking into account customer and sector needs. The report notes that energy efficiency is split amongst different entities (gas utilities, electric utilities/IESO, and at the time of the report, GreenON) all subject to different requirements. Savings in cost, increases in efficiency and enabling greater integration should be a goal for the post-2020 energy efficiency framework.

Other important elements for discussion for the next framework include:

- establishing the primary objective of the framework (e.g., energy savings, reducing peak demand, meeting supply needs, reducing greenhouse gas emissions or a combination of some or all of these goals)
- reviewing the definition of eligible conservation technologies, based on the objectives of the framework
- considering entities for delivering conservation beyond the IESO-LDC-natural gas model, that could be driven by markets
- achieving an integrated sustainability framework with a one-window experience for customers
- implementing a more flexible framework based on a longer-term target, that can be amended periodically without the need to stop and start the framework, and
- considering regional needs by targeting conservation to areas of the province where it may be more valuable in meeting electricity system needs.

Commentary

Several of the issues noted in the IESO's draft report are addressed in more detail later in this chapter (based on publicly available materials), specifically:

- Improving the cost-effectiveness testing used for electricity conservation, including better measuring and valuing greenhouse gas emissions reductions (section 2.4.2), and
- Increasing energy and cost savings and emissions reductions and improving the customer experience, through greater collaboration between natural gas and electricity utilities and/or a single administrator that is responsible for conservation programs for multiple energy sources, including other fuels for which programs do not currently exist (section 2.5).

2.3.2 Moving electricity conservation to the tax base

Spending on electricity conservation is currently charged to all electricity customers under the Global Adjustment, which is part of the commodity cost in electricity bills. There has been a promise from the current government to move some or all of the cost of conservation spending from the electricity bill to the tax base. Conservation costs about $400 million a year out of the $21 billion annual cost of the electricity system.[45] At this point in time, there are no timelines as to when or how this change will be implemented.

The proposal to move conservation spending to the tax base has raised concerns in the industry and amongst stakeholders about the future of electricity

Conservation costs about $400 million a year out of the $21 billion annual cost of the electricity system.

conservation in the province. If the government's main objective is reducing the provincial deficit, spending on electricity conservation that is funded by taxation may face cuts or complete cancellation. In light of the likely focus on cost-cutting, the industry has provided recommendations as to how money can be saved in the current framework.[46]

MENDM has confirmed that reducing electricity rates is a top priority for the government and decisions on conservation policy will be made with this in mind.[47] Given the new policy priorities, MENDM has indicated that the recommendations of the Conservation First Mid-Term Review, presented to the Minister of Energy in July of 2018, are now out of date and therefore not immediately relevant to discussions related to the future of electricity conservation.[48] It is important to note that the province's LDCs have performed exceptionally well in the current 2015-2020 Conservation First Framework, achieving almost 70% of the provincial target halfway through the framework.

Promoting further uncertainty, the government's recently released draft Environment Plan did not mention electricity conservation.

What would happen if we stopped electricity conservation programs altogether?

Cutting electricity conservation programs would make it more difficult for Ontario's electricity system to maintain reliability and deliver enough power to meet Ontario's needs. The IESO's 2018 Technical Planning Conference assumes that about 15 TWh of electricity savings and almost 2,400 MW of peak demand will be achieved from new conservation programs by 2035 (Figure 2.4).[49] To be clear, all of these savings are to be achieved from new (post-2017) conservation activity.

Cutting electricity conservation programs would make it more difficult to maintain reliability.

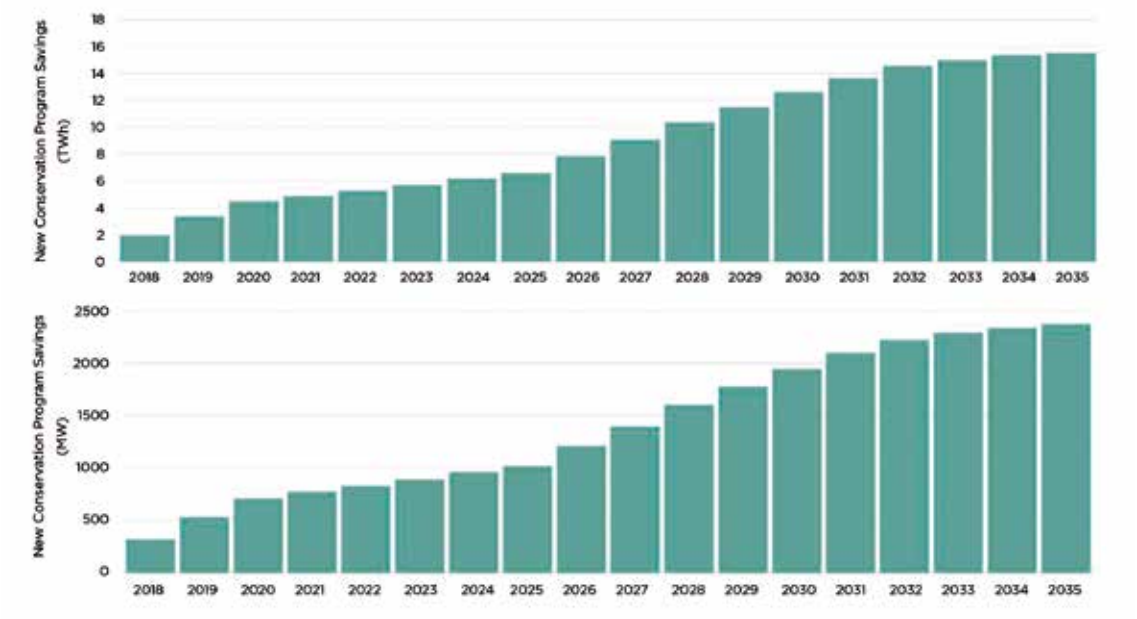


Figure 2.4. Projected electricity and peak demand savings from future (post-2017) electricity conservation programs.

Source: Independent Electricity System Operator, "2018 Technical Conference" (presentation at IESO Technical Conference, September 2018) at 20.

These estimated electricity and peak demand savings from future conservation programs are equivalent to about 10% of Ontario's current electricity supply and peak demand. If conservation programs are cancelled, this energy would have to come from generation resources instead, including new generation or imports.

Even if all of these future conservation savings are achieved, Ontario is forecasting a supply gap beginning in 2023 when long-term contracts start expiring, nuclear generation plants are being refurbished and Pickering nuclear units are shut down (Figure 2.5).[50] This gap has been made larger by recent policy shifts such as the cancellation of 751 renewable generation projects. Cutting conservation programs would increase this supply gap and put Ontario in a precarious position, in need of a large amount of new supply.

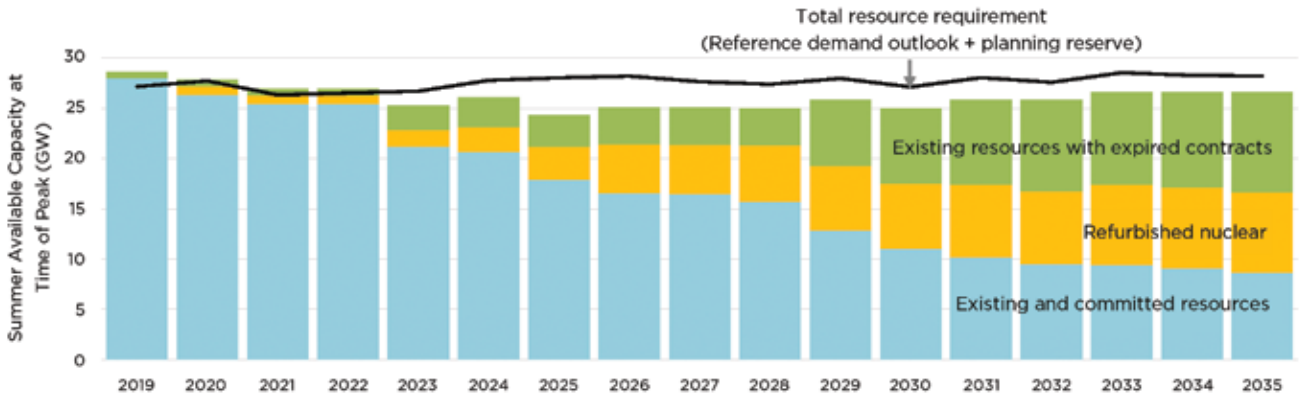


Figure 2.5. Projected future electricity supply gap.

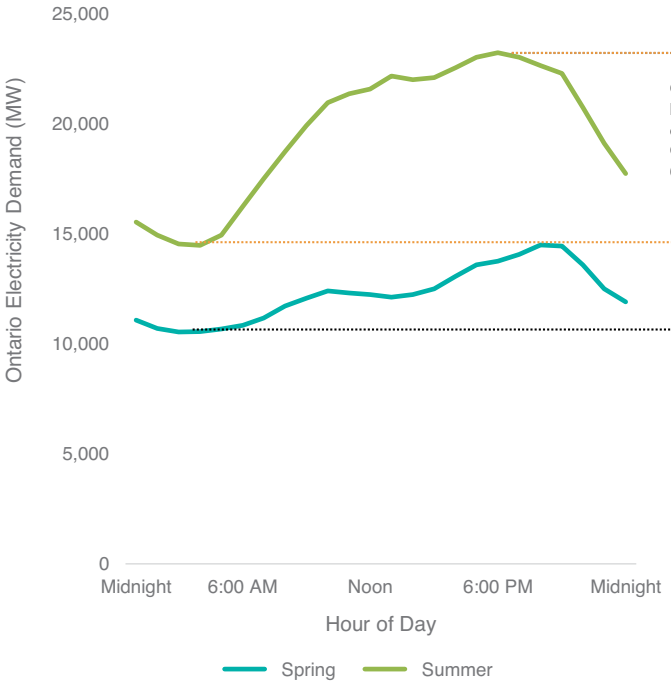
Note: This projection assumes that planned future electricity conservation programs will continue. If this does not occur, the gap between supply and demand would be larger.

Source: Independent Electricity System Operator, "2018 Technical Conference" (presentation at IESO Technical Conference, September 2018) at 50.

While many believe that Ontario has an electricity surplus, this is only true during periods of lower demand, such as spring and fall nights and weekends. During peak summer hours, the province can be in a position where it barely has sufficient electricity to maintain the grid's reliability.

The variability in electricity demand in Ontario depending on the time of the day and on the season is presented in Figure 2.6.

While many believe that Ontario has an electricity surplus, this is only true during periods of lower demand.



Ontario's electricity demand varies greatly by time of day and by season.

Figure 2.6. Variability in Ontario electricity demand.

Note: This is a simplified presentation of electricity demand in summer and in spring on a typical weekday to show the difference in electricity demand.

Source: Independent Electricity System Operator; Environmental Commissioner of Ontario.

There is another reason to continue and enhance electricity conservation, one that is favourable to ratepayers. Conservation remains the cheapest electricity resource, as shown in Figure 2.7. Electricity conservation is a much less expensive way of filling the supply gap than building new generation.

Conservation remains the cheapest electricity resource.

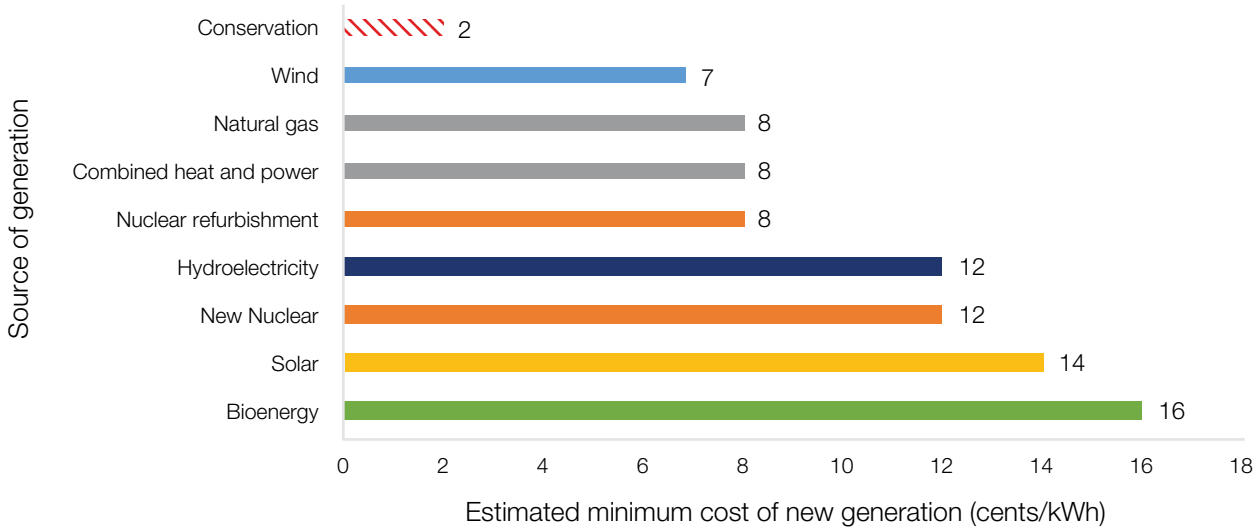


Figure 2.7. Estimated minimum cost of new electricity generation in Ontario, 2016.

Source: Independent Electricity System Operator, information provided to the ECO (31 January 2018).

The IESO now bills taxpayers $2.5 billion/year to keep our electricity system running.

In terms of keeping electricity costs low, another factor is the scheduled expiry of the Fair Hydro Plan in 2022/23. The Fair Hydro Plan has artificially reduced customer's electricity bills by 25%;[51] the IESO now bills taxpayers $2.5 billion/year to make up for this revenue shortfall and to keep our electricity system running.[52] When this artificial discount expires, Ontarians will face a spike in their bills. Conservation programs can help mitigate that increase.

Cutting electricity conservation programs would also make it more difficult for Ontario to meet its climate targets, as GHG-emitting gas-fired electricity generation would need to run more frequently. We will see in section 2.4.2 of this chapter how future electricity conservation could affect greenhouse gas (GHG) emissions, and how improvements could make electricity conservation programs more effective in contributing to the province's climate goals.

2.3.3 More natural gas conservation to fight climate change

The government's draft Environment Plan forecasts that gas utilities conservation programs will deliver 3.2 Mt CO_2e of the government's goal of 18 MT of greenhouse gas (CO_2e)[53] reductions by 2030, as shown in Figure 2.8.[54]

The government forecasts that gas utilities conservation programs will deliver 3.2 Mt CO_2e of greenhouse gas reductions.

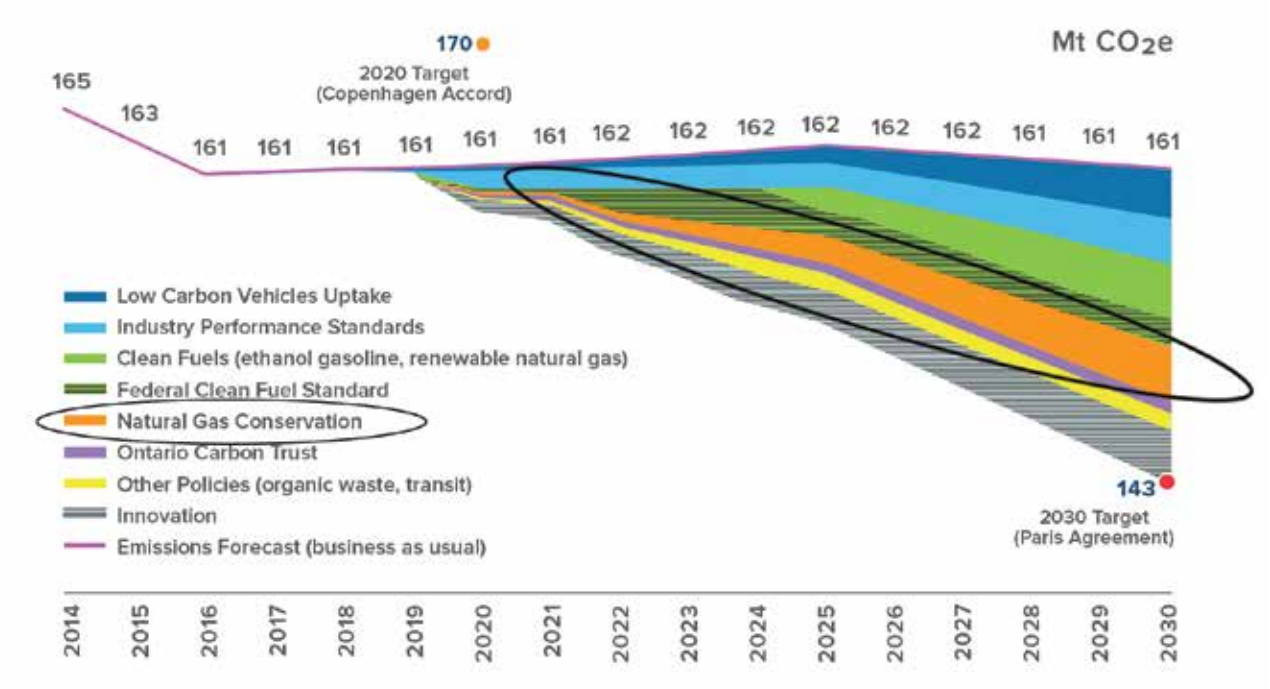


Figure 2.8. Proposed path to meeting Ontario's new, higher 2030 emissions target of 143 Mt CO_2e.

Source: Ontario Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan (Toronto: Queen's Printer, November 2018) at 23.

The government states it will work with the OEB to expand cost-effective natural gas conservation to "simultaneously reduce emissions and lower energy bills".[55] The plan does not provide any details on what those programs will look like, what level of GHG emissions will be reduced from these programs, how much they will cost and what the impact will be on the utility bill. The forecast emissions reductions from expanding natural gas conservation begin in 2021, which may indicate that the government has no plans to alter natural gas conservation programs before the end of the current framework in 2020.[56]

2.3.4 Next steps

Both natural gas and electricity conservation have important roles to play in reducing GHG emissions, in saving money for the province's homes and businesses and in improving the well-being of Ontarians. With the current utility frameworks more than halfway completed, now is an opportune time for Ontario to review utility conservation programs to make them more effective, especially in light of the province's proposed climate goals under its Made in Ontario environment plan. In the next section, we analyze in more detail if the emissions reductions projections in the environment plan are feasible for Ontario to undertake and what more it can do to reduce GHG emissions via energy conservation.

Both natural gas and electricity conservation have important roles to play in reducing GHG emissions, in saving money and in improving the well-being of Ontarians.

2.4. How can Ontario achieve 3.2 Mt CO_2e of emissions reductions from conservation?

2.4.1 Expansion of natural gas conservation

As mentioned earlier, in its draft Environment Plan, the government states that 18% of its GHG reduction goal of 18 Mt CO_2e by 2030 will come from the Natural Gas Conservation Action (see Figure 2.9).[57] This assumes a gradual expansion of natural gas conservation programs delivered by the utilities, subject to discussions and approval by the oversight body for gas conservation, the OEB.[58]

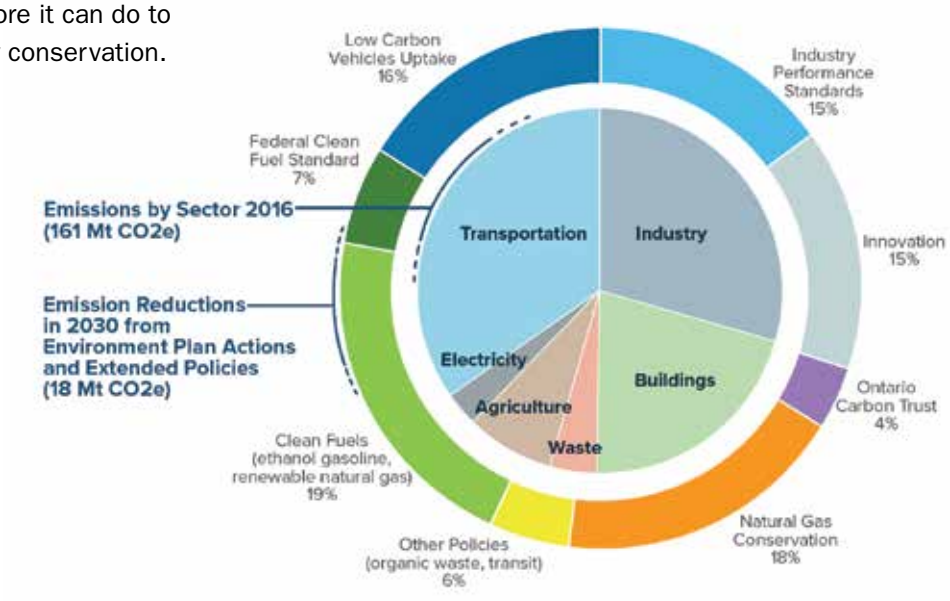


Figure 2.9. Planned emissions by sector and emission reductions actions in 2030.

Source: Ontario Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan (Toronto: Queen's Printer, November 2018) at 24.

Expanding natural gas conservation will have many benefits for Ontarians, including:

- Per dollar spent, natural gas conservation has a greater impact in reducing GHG emissions than electricity conservation does. This is primarily because 94% of Ontario's electricity generation in 2018 was not fossil-fuelled and is not a net emitter of GHGs during operation, whereas essentially all natural gas is fossil-based.[59]
- Natural gas conservation has seen less funding to date than electricity conservation. Despite the fact that the natural gas utilities have seen a significant increase in budget under the 2015-2020 DSM Framework[60], their overall budget is still 1/3 of the conservation budget of the LDCs (See Table 2.1).

Natural gas conservation programs are very cost-effective.

- Natural gas conservation programs are very cost-effective. As discussed earlier in this chapter, every dollar spent on natural gas conservation delivers $2-$3 of value. DSM programs to date have accrued a net benefit of over $5 billion for its customers through reduced natural gas usage and lower energy bills.[61]
- Natural gas is a lower cost household expense than electricity, and natural gas rates have not risen in the same fashion as electricity rates. Therefore, increasing DSM budgets will have a lower impact on customers' pocketbooks (particularly relevant for customers who do not or cannot participate in conservation programs).
- Less natural gas use means more savings for the province as it will avoid out-of-province natural gas purchases (see **Chapter 1**).
- With the government's recent announcement that natural gas access will be expanded throughout rural and Northern Ontario at a cost to all gas customers[62], increased conservation programs may offset the cost and environmental impact of more natural gas access and use.

Some of the benefits associated with expanding natural gas conservation were brought up during the OEB's Mid-Term Review of the DSM Framework. To recognize the importance of the GHG reduction benefits of natural gas conservation, intervenors advocated for the federal cost of carbon to be included in the cost-effectiveness calculations for natural gas conservation programs, a recommendation that has been adopted by the OEB.[63] The 15% TRC adder will continue on top of the federal cost of carbon to account for other non-energy benefits.

Can natural gas conservation achieve 3.2 Mt CO_2e of GHG reductions?

Can natural gas conservation produce 3.2 Mt CO_2e reduction in GHGs by 2030? What will the costs and benefits be?

The OEB completed an Achievable Potential Study in 2016 to assess Ontario's potential for natural gas conservation.[64] The study concluded that Ontario has a range of natural gas conservation expansion options, and the more conservation the province undertakes, the more GHG emissions reductions the province will see. Figure 2.10 presents the potential GHG emission reductions from various natural gas conservation potential opportunities.[65]

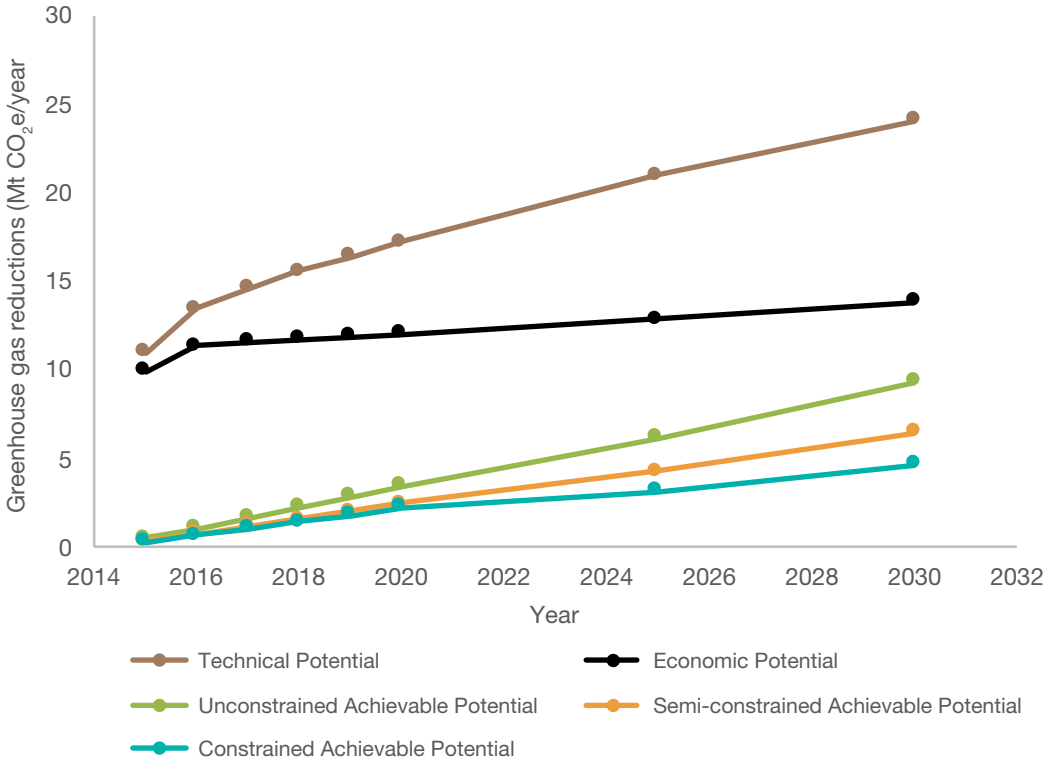


Figure 2.10. Greenhouse gas reductions under all possible natural gas conservation scenarios.

Note: The OEB's report presents GHG emissions in million kg CO_2e. To be consistent with previous ECO reports, this graph is presented in Mt CO_2e.

Source: Ontario Energy Board, Final Report: Natural Gas Conservation Potential Study by ICF International (Toronto: OEB, July 2016) at 7.

The theoretical natural gas conservation potential is very large.

The first thing to note from Figure 2.10 is that the theoretical natural gas conservation potential is very large – almost 25 Mt CO_2e by 2030 if all technically feasible conservation measures are adopted, and almost 14 Mt CO_2e by 2030 if only cost-effective measures (under the economic potential) are adopted. However, as discussed in **Chapter 1** of this report, many barriers prevent customer adoption of all cost-effective conservation opportunities. The three "achievable potential" lines are the OEB's estimates of how much conservation can realistically be achieved from conservation programs at different levels of spending ("unconstrained" = no budget limit or policy restrictions, "constrained" = budgets remain at current levels).

MECP advises that the estimate of a 3.2 Mt CO_2e emissions reduction from natural gas conservation programs by 2030 is the difference between the "unconstrained" and "constrained" lines in the OEB's Achievable Potential Study. The only difference is that the divergence of the two lines begins in 2021 instead of 2015 as shown in the study.[66]

In other words, the 3.2 Mt CO_2e of emissions reductions in the draft Environmental Plan are incremental to what would be achieved by existing

gas conservation programs continuing at their current level of spending. The OEB study estimated that the additional cost under an unconstrained scenario of this extra 3.2 Mt CO_2e of reductions would be about $440-$600 million/year, a fourfold increase from current annual spending levels for natural gas conservation.[67]

The actual cost may be considerably lower.

The actual cost may be considerably lower. An achievable potential study is only one tool. Its estimates are an approximation influenced heavily by the assumptions made. It cannot accurately predict future operational, behavioural and technological changes, and, in particular, the methodology of estimating program costs is very coarse-grained.[68] Policy and tax shifts, for example, can dramatically change conservation outcomes.

New conservation programs may initially have high upfront costs (which is when the financial incentive is helpful in driving participation), but as utilities, vendors, delivery agents and contractors gain expertise and familiarity, benefits such as improved delivery models, more streamlined supply chains and greater competition amongst delivery agents typically lead to lower administrative and financing costs. This drives down the cost of delivering more conservation, benefitting ratepayers, utilities and the overall system. These future benefits are not reflected in the OEB cost estimates as this was not in scope of the 2016 APS. Recent results from electricity conservation programs show how costs can drop with time and experience. While the unit cost of natural gas conservation savings increased in 2016 in the first year of an expanded budget as utilities initiated new programs (**Appendix D**), the cost of electricity savings fell as mature programs built on previous learnings and economies of scale and delivered larger savings (**Appendix C**). Costs for delivering demand response programs have also fallen 42% in the past three years.[69]

Some increase in spending to pay for more natural gas conservation makes sense, as the current natural gas conservation budget is capped by the OEB at a very low level of $2 per residential bill. However, some are concerned that most of the benefits of natural gas conservation programs (except the important benefits of reduced greenhouse gas emissions) go to conservation program participants, and not to non-participating ratepayers. Some of the steps that natural gas utilities can take to address this concern are:

1. expanding participation in conservation to more customers, particularly customer groups who have typically had low participation rates in conservation programs, such as small businesses, and

2. using gas conservation to reduce spending on new infrastructure, which benefits all customers. The textbox “Gas conservation and infrastructure planning” details the gas utilities’ findings about including gas conservation as part of larger infrastructure planning.

Gas conservation and infrastructure planning

When the 2015-2020 DSM Framework was established further to a Directive, the OEB was asked to take such steps as it considered appropriate towards the government policy of putting conservation first in gas infrastructure planning processes.[70] The OEB subsequently directed the gas utilities to conduct a study and prepare a transition plan to show how they would include gas conservation into infrastructure planning in time for the mid-term review.[71] The expectation from the OEB was that gas utilities would consider the role of DSM in reducing and/or deferring future infrastructure far enough in advance so that DSM can be reasonably considered a viable alternative.[72]

Enbridge and Union retained ICF Consulting to undertake an integrated resource planning (IRP) study to assess if conservation could replace or postpone the need for new infrastructure in the short to medium run, saving the ratepayer money. The study found that there is currently very little activity across North American utilities to directly reduce/defer new infrastructure investment using DSM programs.[73] A preliminary study of existing DSM data indicated that targeted DSM may have the potential to reduce some infrastructure investment.[74] However, major regulatory and policy changes will be required to facilitate such a transformational shift along with changes in the utility planning processes.[75] The study recommended further analysis and case studies before making any major changes. Therefore, the gas companies were hesitant to commit to considering conservation as an alternative to infrastructure investment, based on current barriers highlighted in the report.[76]

ICF's analysis suggested that up to 1.2% of demand growth per year may be offset by geo-targeted DSM program[77], but there is need for further research and testing with real data and actual costs before gas utilities can consider DSM to be part of IRP.

Based on ICF's study, Union and Enbridge filed a transition plan with the OEB that acknowledged that the current DSM framework and IRP regional process are independent of each other but now there is an increased need to incorporate energy efficiency, demand response and carbon-reduction into the natural gas infrastructure plans.[78] The utilities are now completing in-field studies to understand the impact of DSM on peak hour demand and the associated cost-benefit analysis of choosing DSM over new construction. Maintaining reliability requirements and the overall impact on the customers' bill are also important considerations of this study, as is the growing importance of reducing GHG emissions.[79] The in-field studies will be completed in 2019 and the results, along with relevant decisions/directions from the OEB and the government will determine next steps for the gas utilities.

The transition plan does not include any firm commitments from the gas utilities to incorporate DSM into their IRPs. In its final DSM Mid-Term Review Report, the OEB is pressing for stronger action from utilities in this area, noting that "the transition plan does not advance the understanding of the role and impact that energy conservation can play in deferring or avoiding capital projects".[80] The OEB has indicated that gas utilities will be required to demonstrate that they considered conservation as an alternative as part of an application for new growth-related infrastructure.

The ECO recommends that the Ministry of Energy, Northern Development and Mines grow natural gas conservation funded by ratepayers, while looking at ways for more natural gas customers to benefit, such as expanding participation in programs, and using conservation to avoid infrastructure investments.

2.4.2 Focusing electricity conservation on times of high demand

While the province's immediate focus on expanding natural gas conservation makes sense, the role of electricity conservation in reducing GHG emissions must not be ignored. With the current conservation framework expiring in 2020, the province should make electricity programs more effective in reducing GHG emissions as well as saving money and improving well-being.

How would GHG emissions change if electricity conservation programs were cancelled?

The Ministry of Environment, Conservation and Parks (MECP) has indicated that the overall emissions

projections in the government's draft Environment Plan includes a baseline of electricity sector emissions from the 2017 Long-Term Energy Plan (LTEP), represented by the black line in Figure 2.11.[81]

However, policy changes such as cancelling the cap-and-trade program and 751 clean energy projects mean that the IESO now forecasts higher emissions than the LTEP had projected (green line in Figure 2.11).

The LTEP forecast also assumed that electricity conservation programs would continue.

If the province were to cancel electricity conservation programs, this would offset most of the potential emissions reductions from expanding natural gas conservation.

If the province were now to cancel electricity conservation programs, emissions from the electricity sector would rise even more (blue line in Figure 2.11), by an additional 2 Mt CO_2e by 2030, and 2.5 Mt CO_2e by 2035. This would offset most of the potential emissions reductions from expanding natural gas conservation.

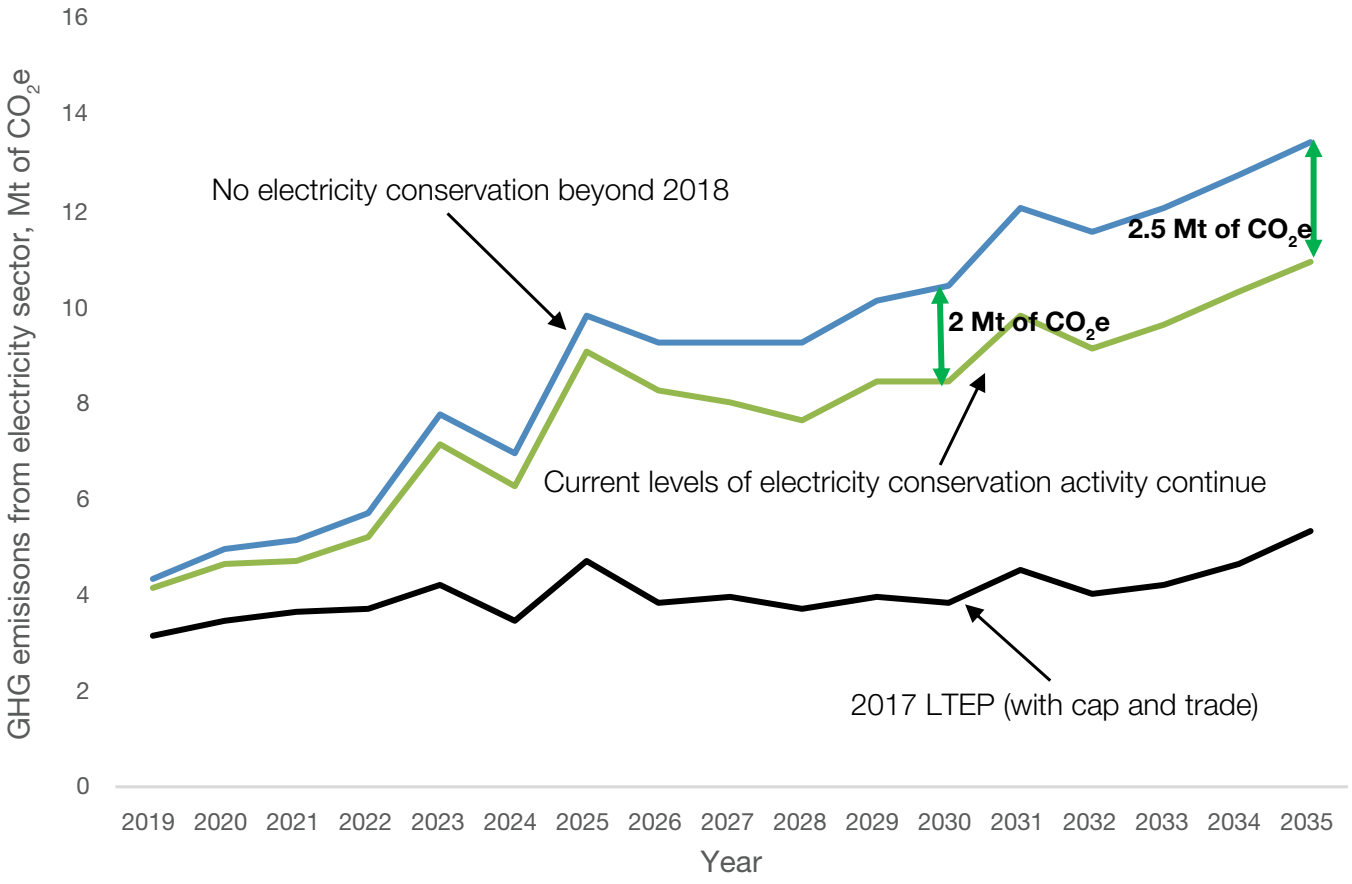


Figure 2.11. Change in greenhouse gas emissions from the electricity sector, if current programs were cancelled, 2019-2035.

Source: Independent Electricity System Operator, Information provided to the ECO (22 February 2019).

The reason for the increase in GHG emissions is that, in the absence of conservation, GHG-emitting gas-fired electricity generation would run more frequently, particularly after the Pickering nuclear station is closed down in 2024. Therefore, cancelling electricity conservation programs would be counter to the province's climate goals. The IESO's analysis emphasizes the continued need for electricity conservation in the province, particularly those programs that help reduce peak electricity use, when gas-fired generation is running.

Not all electricity conservation is of equal value.

Better targeting of electricity conservation to reduce greenhouse gas emissions

The 2015-2020 Conservation First Framework mandates LDCs to deliver programs that reduce overall electricity consumption, no matter what time of the day it occurs. **Appendix C** details the continued success of the LDCs in delivering those programs, but the conservation target is not the best metric. Not all electricity conservation is of equal value. Conserving electricity during nights and weekends (particularly in the spring and fall) provides only limited benefits to Ontario. During those times, Ontario often has surplus baseload generation, i.e. demand is less than the electricity that is generated by nuclear, hydro and other variable renewable generation. Because Ontario has limited storage capacity, such power must be used when generated or it has to be curtailed. In the near term, conservation during those hours does not have much value – it may lead to more exports of electricity to other jurisdictions at relatively low prices, or even curtailment, which provides no financial savings at all.

Conservation during times of high demand (usually summer and winter weekdays) has a much larger public and climate benefit.

Conservation during times of high demand (usually summer and winter weekdays) has a much larger public and climate benefit than conservation during off-peak. In Ontario, high demand is mostly met by increasing the use of peaking gas-fired generation, which means conservation during those hours reduces operating (fuel) costs of existing generators, defers the need for building new expensive assets to meet that higher demand, and reduces GHG emissions.

The selection of conservation programs offered in Ontario is based in part on how programs score on cost-effectiveness tests. Minor improvements to the current cost-effectiveness testing could prioritize electricity conservation at the times when it is most valuable. There are two separate (but closely related) issues:

- The values used to assess the benefits to the electricity system from conservation at different times of day and season are outdated, and do not reflect current supply conditions,
- No attempt is made to accurately measure or value the greenhouse gas reduction benefits from electricity conservation, and how these benefits differ by time of day and season.

Outdated cost-effectiveness inputs: Ontario's evaluation methodology for electricity conservation programs does attempt to measure how the value of electricity savings will differ, depending on the time of day and season when the savings occur.

But the inputs used are outdated (from 2014). This means that the test no longer accurately identifies what type of generation is being avoided in a given hour through conservation, and therefore what the benefits of conserving energy would be. In particular, the outdated numbers mean that electricity conservation in off-peak hours is valued more highly than it should be. Conservation programs that save electricity primarily at night when electricity demand is lower (such as more efficient residential lighting) are incorrectly considered to be almost as valuable as programs that save electricity during peak hours.[82]

No accuracy in valuing or measuring greenhouse gas emissions reductions: The other missing element in calculating the cost-effectiveness of electricity conservation is accurately measuring and explicitly valuing greenhouse gas reductions. GHG reductions only occur if conservation can reduce the use of gas-fired generation, so reductions vary wildly depending on when electricity conservation occurs. The IESO's analysis shows that on average, electricity conservation during summer peak periods in 2018 delivered roughly eight times the amount of GHG reductions per unit of electricity saved as did conservation during shoulder off-peak periods.[83] Updating the cost-effectiveness inputs will make it easy to accurately calculate GHG reductions.

The next step is to place a value on these emissions reductions. The current approach in cost-effectiveness testing is to simply increase the calculated net benefits of conservation by 15% to account for all "non-energy benefits",[84] including greenhouse gas reductions.[85] This valuation is not tied to the actual emissions reductions achieved by a conservation program, or the market or societal value for emissions reductions. It would be better to use an explicit value for emissions reductions – as noted, the OEB has mandated that the federal carbon price be used in natural gas conservation cost-effectiveness testing.

The good news is that the IESO has done most of the analytical work needed to address these problems. The bad news is that implementation of these updates as they relate to conservation program selection and analysis is on hold; pending further discussions with the Ministry of Energy, Northern Development and Mines on the future of the electricity conservation framework, the current evaluation inputs and methodology will continue to be used.[86] The textbox "IESO's progress on updating the cost-effectiveness methodology and inputs for conservation programs" provides more details on the latest development on updating those numbers.

IESO's progress on updating the cost-effectiveness methodology and inputs for conservation programs

The IESO had informed the ECO earlier in 2018 that its Cost-Effectiveness (CE) Tool used for conservation program analysis was being updated to account for GHG savings and to update avoided cost assumptions.[87]

As part of the update process, the IESO developed a set of emission factors (tonnes of CO_2/MWh of electricity consumption) for the time period of 2015-2035 using the IESO's standard time of use periods based on the generation forecasts of the 2013 Long-Term Energy Plan. Based on a conservation measure's load profile and using an assumed societal benefit of GHG reductions ($/tonne), the IESO could then calculate the lifetime CO_2 savings and the net present value associated with the avoided CO_2 emissions from that measure, and incorporate these benefits in cost-effectiveness testing.[88]

The ECO was initially informed that the updated CE tool would be in use as early as Q3 of 2018 (pending some updates by IESO's planning department), with the updated inputs and cost-effectiveness methodology to be used for evaluation of conservation program results (beginning with 2018 results) and for conservation program screening/review for 2019 and 2020.

However, with the change in government in 2018, the IESO has recently informed the ECO that these plans are on hold. Work to accurately calculate avoided costs and GHG reductions continues, but these updates are not yet being used for conservation program analysis. The value assigned to GHG reductions may also change, to reflect the cancellation of the cap and

trade program and its replacement by carbon pricing at the federal level.[89]

For the time being, in its conservation program analysis, the IESO will continue to use the current avoided costs and related inputs, pending further discussions with the government on the remainder of the 2015-2020 Conservation First Framework.[90] As a result, the IESO will continue to use a version of the CE tool with outdated avoided costs and the use of a 15% adder to account for all non-energy benefits, including GHG emission reductions.

In the meantime, current electricity conservation programs fail to focus conservation during hours of high demand when the province needs it the most. If these problems with cost-effectiveness testing were fixed, conservation programs that preferentially reduce electricity consumption during on-peak gas-generating hours would score better, relative to programs that save energy more evenly across all hours.[91] If electricity conservation budgets end up being reduced, these changes would enable Ontario to get better value from the money it is spending on electricity conservation, and ensure that the most valuable programs are preserved.

Current electricity conservation programs fail to focus conservation during hours of high demand when the province needs it the most.

The primary performance metric for utility conservation performance (on which utility incentives are based) is currently overall electricity savings. As a related change to further prioritize valuable programs that reduce GHG emissions, the province should make GHG reductions an explicit performance metric, that complements the metric of overall electricity savings.

These changes would have a two-pronged benefit for the province along with the reduced electricity use. One, the province would save money because peaking gas plants would run less; and two, there would be environmental benefits in the form of lower GHG emissions and better air quality. This would support natural gas conservation in meeting the 3.2 Mt CO_2e emissions reduction goal.

While the IESO is also responsible for procuring demand response resources to reduce peak demand during the hours of the day electricity demand is at its highest, these resources are not a complete substitute for electricity conservation programs. Demand response initiatives deliver few greenhouse gas reductions or overall energy savings, because they are activated so infrequently (see **Appendix C** of this report for more details). Conservation programs that can reduce electricity consumption, peak electricity demand, and greenhouse gas emissions would add greater value to society.

While the province prioritizes natural gas conservation to meet its climate goals, electricity conservation should not be forgotten.

The ECO recommends that the Ministry of Energy, Northern Development and Mines focus electricity conservation on programs that save electricity during hours of high demand, when fossil fuels are being used to generate electricity.

The ECO recommends that the Ministry of Energy, Northern Development and Mines accurately measure and value greenhouse gas reductions from energy conservation programs, including valuing the benefits of emissions reductions in cost-effectiveness testing (using up-to-date inputs), and making greenhouse gas reductions a performance metric for utilities or other conservation providers.

2.4.3 Reducing greenhouse gas emissions through multi-fuel conservation

So far, we have talked about natural gas and electricity utilities that separately deliver conservation programs to Ontarians. While collaboration with one another is encouraged in both industries, actual examples of collaboration in the current framework are minimal. Greater collaboration between Ontario's utilities would in many cases mean lower costs for the utilities and in turn for the ratepayers, more opportunities to reduce GHG emissions, and a more streamlined approach to improve the energy efficiency and well-being of Ontario homes and residents. Reviews of several top-performing jurisdictions indicate that coordinated efforts to offer electricity and gas efficiency programs together can have significant success in terms of energy savings and also in terms of cost savings for the utilities and, in return, for the customer.[92]

Coordinated efforts to offer electricity and gas efficiency programs together can have significant success.

In addition, certain opportunities to reduce GHG emissions, such as conservation of fuels other than electricity and natural gas, and fuel switching between energy sources, do not fit neatly into the current electricity and natural gas conservation frameworks, and would be better addressed in a multi-fuel approach.

The next section explores some of those opportunities.

2.5. Multi-fuel conservation and collaboration

Today, more and more jurisdictions are considering some form of integrated operations that address multiple energy sources, when designing and delivering energy efficiency programs.[93] A more integrated approach can save the customer time and money, lower administrative costs, expand conservation programs and drive more energy and GHG reductions. Some of the benefits include:

- **Making customer participation easier:** Currently in Ontario, if a homeowner is considering renovating their home to make it more energy efficient and the home uses both electricity and gas for heating, cooling and other functions, the homeowner has to contact both the gas and the electric utility separately to take advantage of utility conservation programs. This means that if the homeowner wants to maximize his/her home's energy efficiency during the renovation, it will require separate contractors recommending a different set of allowable measures and then implementing those measures separately in the home. For homeowners and businesses, the process can be confusing and onerous, sometimes leading to non-participation. For a commercial or industrial customer, dealing with separate utilities may not make an attractive enough business case, but dealing with one contractor for all conservation programs may convince the customer to participate.
- **Reducing GHG emissions:** Gas and electricity conservation programs currently do not include GHG reductions as a performance measure for their programs. Coordination between gas and electric utilities could ensure a consistent methodology that calculates the societal benefit of GHG reductions and establishes corresponding GHG targets, along with reductions of electricity and natural gas. Coordinated delivery could also support fuel switching when it makes sense and lead to GHG reductions (this is discussed in further detail later in the chapter). US states like Texas have set energy-efficiency goals to "be neutral with respect to specific technologies, equipment and fuels" as long as it "results in overall lower energy costs, lower energy consumption and high-efficiency equipment".[94] While GreenON programs had some of these elements, there were other logistical issues with the organization, as discussed in the textbox "GreenON: Ontario's experiment with multi-fuel conservation".

- **Lowering administration costs:** The electricity conservation programs and the natural gas conservation programs have separate marketing brands and materials and often have separate vendor and contractor agreements in the same jurisdiction serving the same customer. More collaboration would lead to lower program delivery costs and overheads, ranging from fewer site visits from contractors, integrated advertising and marketing and coordinated program administration.
- **Supporting more technologies:** A gas or electricity-only conservation measure that may not be cost-effective on its own due to high program costs relative to the savings may become cost-effective and therefore eligible for delivery under a collaborative delivery model or when combined with measures that reduce use of another fuel. This can also increase the diversity of the program portfolio for both utilities, allowing for greater customer participation and greater savings in energy and GHGs.
- **More accurate accounting:** Many energy conservation initiatives have interactive effects between fuels – e.g. improving the efficiency of building lighting may be done as an electricity conservation measure; however, it will also usually increase natural gas use for heating. Fuel switching, by its nature, will increase the use of one energy source, while reducing the use of another. These interactive effects can be considered better if there is more coordination amongst utility conservation programs.

2.5.1. Existing collaboration between Ontario electric and natural gas utilities

The natural place to begin a discussion of multi-fuel conservation is with collaboration between gas and electric utilities. Despite the potential benefits listed above, actual collaboration amongst gas utilities and LDCs has been limited given regulatory and coordination challenges, as noted in the electricity conservation mid-term review, despite customer interest in an integrated energy management approach.[95]

Actual collaboration amongst gas utilities and LDCs has been limited.

The textbox "LDC-Gas conservation collaboration examples" details some of the limited examples of collaboration to date.

LDC-Gas conservation collaboration examples

Toronto Hydro-Enbridge Smart Thermostat Initiative

In Q4 of 2016, Toronto Hydro and Enbridge Gas launched a local smart thermostat program for Toronto residents who were customers of both the utilities. The pilot offered customers a $100 rebate (either as an Enbridge bill credit or as a cheque) if they purchased and installed a qualifying smart thermostat. The cost of the $100 rebate was shared between Toronto Hydro and Enbridge for participants who signed up for the Enbridge program but also had central air conditioning. The program experienced some slowdown when GreenON started offering the same thermostats at $0 cost in the summer of 2017. However, with the cancellation of the cap –and-trade framework, the pilot was expected to run until the end of 2018.[96] Since the launch

of the program, close to 10,000 households have participated in the program.[97] While verified results are not available yet, the business case has estimated 233 kWh of gross savings and 174 kWh of net electricity savings per device.[98]

One of the Ecobee thermostat models available under the Smart Thermostat Program.

Photo credit: Toronto Hydro.

Niagara Peninsula Energy's Energy Concierge Program

Niagara Peninsula Energy Inc. (NPEI), in collaboration with Enbridge Gas Distribution and Ontario Restaurant Hotel & Motel Association launched an Energy Concierge Program in 2015, that targeted the hospitality industry situated in NPEI's jurisdiction. The program offered a comprehensive set of electricity and natural gas savings initiatives. Participants included large establishments such as the Fallsview Casino Hotel and the Marriott Getaway in Niagara Falls.[99] As part of the initiative, participants are provided with a customized 3-year energy management plan that identifies energy efficiency opportunities using existing province-wide CDM and DSM programs, along with some new measures tailored to the hotel/motel sector.[100] The pilot has achieved electricity savings of 42.6 MWh.[101]

Old air- conditioning unit (left) at the Peninsula Inn Hotel in Niagara Falls switched for an energy efficient packaged terminal heat pump unit (right) under the pilot.

Photo credit: Niagara Peninsula Energy Inc.

IESO, Gas Utilities run Whole Home Pilot

On June 10, 2016, the Minister of Energy directed the IESO to develop a province-wide Whole Home Pilot Program for residential customers and deliver it, where appropriate, with the gas utilities. IESO launched the program in May 2017 as a "one-window, one service provider multi-fuel efficiency program", to be delivered by Enbridge and Union Gas and their service providers. The Pilot was an enhancement of the gas utilities' existing Home Energy Conservation Program by adding on electricity measures and expanding eligibility to electrically heated customers. For example, a customer undergoing insulation and furnace upgrades to save natural gas would now also have their home assessed for measures that would save electricity (accompanied by supporting incentives), such as high-efficiency air conditioning and appliances. Approximately 24,000 homes participated in the pilot. In the first thirteen months (for which evaluated results are available), the program delivered an additional 11.5 GWH of electricity savings.[102]

Was the pilot successful in getting customers to install add-on electricity-savings measures? More than 82% of the customers whose homes were heated with natural gas also chose to install one or more electricity-savings measures.[103] However, these numbers are skewed because one of the electricity-savings measures (a furnace fan) may have been installed even under a gas-only program (as part of a furnace upgrade). Roughly one-third of participants also installed high-efficiency air conditioners, while only a small percentage of participants upgraded their electrical appliances.[104]

In terms of the customer experience, initial evaluation had shown that customers were satisfied with the "one stop" approach, with over 80% reporting they would recommend the program and over 80% of the customers were satisfied with both the pre and post-renovation audit process.[105]

Financially, however, the add-on electricity measures did not prove cost-effective; the incremental operational costs and incentive costs outweighed the electricity savings from these measures.[106] This was due in part to the fact that the energy savings for some technologies were lower than expected, and a different choice of measures (such as direct install LED lighting) might have delivered lower-cost savings. However, it was also the case that additional administrative costs and higher audit costs (to allow for the additional assessment of electricity-saving opportunities in the house) accounted for more than one-third of the program budget.[107] This was only a pilot program, and administrative costs would likely drop in the future.[108] However, because the pilot was not cost-effective, it stopped accepting new participants at the end of October 2018 once the budget was exhausted. It will not transition to a full province-wide program.

To conclude, the Whole Home pilot's attempt at integrating conservation of multiple energy sources was a success from the perspective of customer experience, but not from a financial perspective. It is unfortunate that the program evaluation did not specifically examine whether opportunities for administrative efficiencies had been maximized, and whether the joint program delivered more savings, or savings at a lower unit cost, than separate stand-alone programs. These questions should be a part of any future evaluations of programs with multi-fuel collaboration.

Table 2.3, which was developed by the IESO's consultant during the electricity mid-term review, shows that there are many similarities between existing electricity and natural gas conservation programs.

Table 2.3. Current CDM and DSM program similarities.

ELECTRICITY PROGRAMS	NATURAL GAS PROGRAMS: Custom Industrial	Custom Commercial	Commercial & Industrial Direct Install	Commercial & Industrial Prescriptive	Savings by Design – Commercial	Run it Right (Run Smart)	Comprehensive (Strategic) Energy
Retrofit (prescriptive and custom)	✔	✔	✔	✔			✔
Audit Funding			✔				
Energy Managers							✔
Process & Systems	✔					✔	✔
System Re-Commissioning						✔	
New Construction					✔		
Monitoring and Targeting						✔	✔

Note: the tick mark indicates that the programs have a similar component.

Source: Independent Electricity System Operator, "Conservation Framework Mid-Term Review: Collaboration" (presentation at IESO Mid-Term Review Advisory Working Group, 27 April 2017), slide 59, online: <www.ieso.ca/-/media/Files/IESO/Document-Library/engage/cf/CF-20170427-Collaboration.pdf?la=en>.

There are currently no incentives for utilities to collaborate.

Given the similarities between programs and some of the benefits we have already discussed, why is there limited collaboration amongst Ontario's utilities? Some of the reasons are:

- There are currently no incentives for utilities to collaborate, nor penalties for not collaborating. When the LDCs were offered a higher performance incentive for delivering programs jointly under the CFF, the province saw 16 joint CDM plans which captured 83% of the province's target.[109] Without a proper incentive or penalty, utilities may be risk-averse to using up resources on collaboration, if they are not certain this will increase results.
- The difference in the number of LDCs and the number of gas utilities can also be considered a barrier to collaboration. With 1 dominant gas utility in the province and around 65 LDCs, the logistics behind collaboration are quite difficult. A smaller LDC may not have the same level of funds and other resources to work with a much larger gas utility, and the gas utility may not want to devote the effort to develop partnerships with each LDC individually.
- The risk of sudden policy changes can also create concerns regarding collaboration. As Table 2.1 shows, the conservation framework for the gas

companies is overseen by the OEB while the oversight of electricity conservation is with the IESO. While the government can issue policy directives to either the OEB or the IESO, the quasi-judicial status of the OEB makes it seem more arms-length. The IESO is often mandated to make changes by the Ontario Minister of Energy's office via Directives, and the Minister of Energy has issued six Directives to date to establish and amend the Conservation First Framework. Therefore, there may be hesitation, particularly from gas utilities, to collaborate when there is a chance that the electricity framework elements might change without sufficient notice.[110]

- There is concern that collaboration will mean diluting the utilities' existing customer relations. Most households, businesses and industries in Ontario are both gas and electricity customers, and when it comes to marketing conservation programs, LDCs and gas companies are often competing for the same customer's attention. Utilities remain concerned that the positive customer relationship that has been built over the years because of billing and other account activities will be diluted if the program is jointly marketed and delivered.
- Tracking costs and attribution of benefits to each of the utilities, specifically if a measure has savings of both fuels, is currently unclear. Managing vendor and contractor relationships can also become an issue especially if the utilities had different delivery agents before coordination. However, the reverse also holds true – currently, an energy service provider may be dealing with multiple utility contracts, for programs that could be delivered in one coordinated effort.[111]

While Ontario's electricity and gas markets are unique in many ways, other jurisdictions facing similar challenges have successfully coordinated separate single-fuel utilities. The textbox "Successful gas-electricity collaborations" highlights some success stories where separate gas and electric utilities have been successful in collaborating to offer coordinated programs to their customers.

Successful gas-electricity collaborations

EfficiencyCrafted New Homes by AEP Ohio and Columbia Gas of Ohio[112]

American Electric Power (AEP) Ohio and Columbia Gas of Ohio, distributing electricity and natural gas respectively in the state of Ohio, launched this residential new construction program in 2010 without any policy or regulatory mandates to collaborate. Both utilities were motivated to increase savings and reduce expenses through a coordinated program. The program was also expected to address market barriers such as upfront costs, lack of education amongst building developers and customer confusion arising from two utilities offering programs for one home. This program is aimed at builders of single-family (attached and semi-attached) homes and multifamily residential units that meet certain requirements. One of the benefits of this coordinated design and delivery model is that builders face a single technical criteria and a single application process, which reduces upgrade decisions and reduces administrative hassles. This also translates to lower costs and sharing of those costs for the utilities. All program materials, which went through several rounds of negotiations, now include the name of the program "EfficiencyCrafted" and the logos of both utilities. Therefore, the customer receives a single consistent message that reduces confusion and increases brand awareness, driving participation.

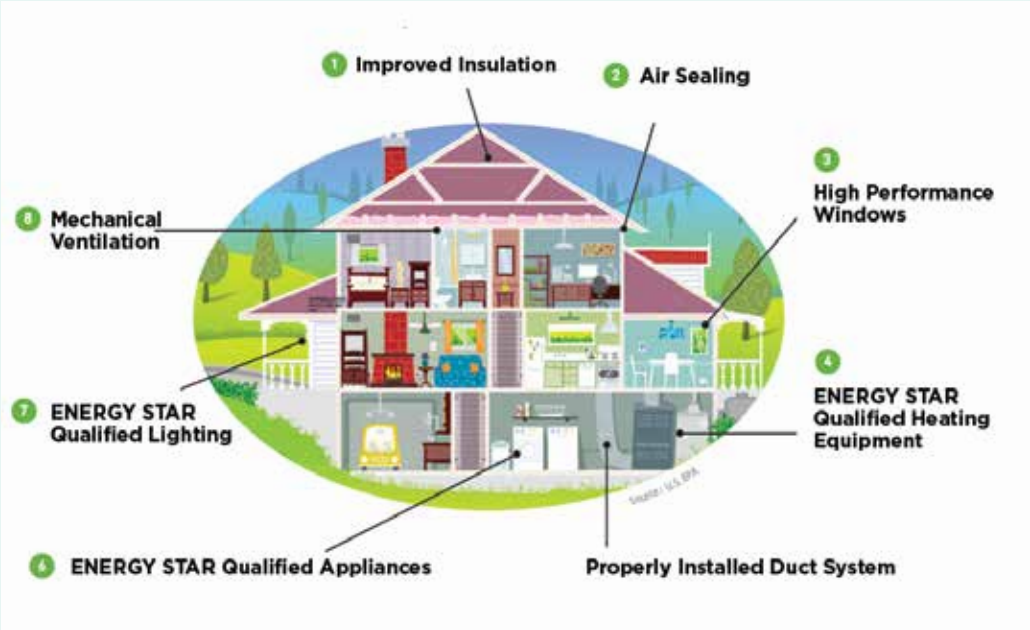


Figure 2.12. Snapshot of EfficiencyCrafted New Homes measures.

Source: American Electric Power Ohio, information provided to the ECO, 4 March 2019.

Under this program, each utility has signed a separate agreement with a single contractor who implements the program on behalf of both utilities. A program manager, along with support staff, are assigned by each utility to handle the daily interactions with the contractor. Since there is only one contractor, program management costs such as administrative expenses, staff training and marketing are split appropriately between the two utilities. Incentives paid to builders are predetermined based on new homes meeting Home Energy Ratings (HERS)/ ENERGY STAR certifications, and each utility claims the savings for its respective fuels when the incentive is paid. Columbia Gas recovers program expenses through a DSM rate rider while AEP Ohio collects via a rider on residential electric bills.

The program currently has a 34% market penetration, with over 9000 units completed under the program to date.[113] Average electricity savings per unit is 3000 kWh and average incentive paid out per home is $562.[114] The Program scores 1.7 on the Total Resource Cost score and 3.4 on the Program Administrator Cost score which means that the program is cost-effective overall.[115] In 2017, the program saved 5300 MWh of energy consumption and 2.8 MW of peak demand, which were 112% and 286% over the program's 2017 energy savings and peak demand savings targets.[116] Its forecasted budget in 2017 was $2 million, but actual expenses came in at $2.2 million, with over $990,000 paid in customer incentives.[117]

Commercial Direct Install (CDI) Program by SoCalGas and LADWP

In 2012, Southern California Gas (SoCalGas), which delivers natural gas in Southern California, and the Los Angeles Department of Water and Power (LADWP) signed a master partnership to allow both utilities to develop standard procedures and criteria that would enable joint program design and delivery.[118] This master agreement was set up because the regulatory bodies for both utilities were making energy efficiency at the local and

at the state level a bigger priority. With LADWP facing higher energy efficiency goals, it proposed a formal agreement with SoCalGas to allow for faster program delivery and greater customer participation, both of which would drive greater energy savings. For SoCalGas, gas-only measures installations was not cost-effective and therefore made business sense to partner with LADWP in the design and development of this business sector program.[119] Since the launch of the Commercial Direct Install (CDI) Program in 2012, 21,000 small businesses have benefitted from free energy and water efficiency upgrades.[120]

The CDI Program is available to all business or other non-residential customers in the city of Los Angeles that have an average monthly electricity demand of 250 Kw of less.[121] Some of the measures included in this program are: [122]

- energy efficient lighting retrofits
- LED signs
- low flow water devices
- hot water pipe and tank insulation, and
- faucet aerators.

LADWP has taken the lead in developing marketing materials, which displays both company's logos. LADWP manages the vendor and consults with SoCal on program changes and monthly reporting. One of the major hurdles that both utilities had to overcome is the fact that the utilities are regulated and funded under different rules- LADWP is an Investor-Owned Utility (IOU) and SoCalGas is a Publicly Owned Utility (POU). While historically this made collaboration between IOUs and POUs difficult, these two companies resolved the problem by one company, LADWP, incurring all costs up front and invoicing SoCalGas on a quarterly basis.[123]

Since each company is under different regulatory frameworks, the program evaluation requirements are also different. Each utility performs evaluations for their respective resource and share all relevant program information and results between the utilities to minimize customer inconvenience.[124]

Since LADWP and SoCalGas have signed this master agreement, they have co-funded 18 programs at an operating budget of $80 million per year.[125] SoCalGas has also set up similar agreements with other municipalities such as Riverside, Pasadena, Anaheim and Metropolitan Water District.[126] These agreements have led to savings of over 44 GWh between 2013 and 2017.[127]

Top-performing US jurisdictions in overall energy efficiency tend to have combined gas and electricity conservation programs.

2.5.2 Encouraging Ontario's utilities to collaborate more

Greater collaboration between the gas utilities and LDCs can increase customer participation and bring in more energy savings, lower program administrative costs, lead to greater GHG savings and improve the well-being of more Ontarians. Rankings by the American Council for an Energy-Efficient Economy (ACEEE) have shown that top-performing US jurisdictions in overall energy efficiency tend to have combined gas and electricity conservation programs.[128] Some of the tools that the province could use to encourage LDC-gas collaboration include:

- Developing the proper tools so that utilities are able to quantify their efforts. The examples in the textbox "Successful gas-electricity collaborations" highlight the fact that the utilities collaborating established clear savings attribution rules at the outset to ensure

savings are not missed or double-counted. To track savings properly, evaluation tools need to take account of any interactive effects between fuels (e.g. whether an electricity savings measure increases or decreases natural gas use), and must also include the proper accounting of GHG reductions to drive those programs that have the biggest impact in reducing carbon emissions.

- Conservation reporting tools could also be updated to encourage LDCs and natural gas companies to collaborate. Current CDM and DSM Plans could be amended to indicate a utility's efforts to collaborate across fuels. Developing matrices that quantify and track customer convenience and increased participation would also highlight the benefits of collaboration across industries.
- Current regulations need to be changed so that the oversight bodies can take appropriate actions to encourage collaboration. The IESO and the OEB could establish other incentives to collaborate with the other major fuel provider, such as faster approval timelines or more flexibility around cost-effectiveness for CDM/DSM plans that include an LDC-gas program, or apply penalties for lack of collaboration. While the government could take a more direct route of making LDC-gas collaboration mandatory, this may place undue administrative and cost burdens on the utilities.

Long-term commitment to energy efficiency is needed to ensure that utilities do not get "cold feet".

- Long-term commitment to energy efficiency is needed to ensure that utilities do not get "cold feet" when it comes to making significant decisions about investing in energy conservation. Gas-LDC collaboration requires extensive commitment from all parties in terms of time, expertise and other resources to see through the design and then the implementation process before a joint program will see success. Moving forward, if the province wants to encourage substantial LDC-gas collaboration in energy conservation, then there needs to be a long-term commitment towards energy conservation from the government as well. A stable framework will assure LDCs and the gas utilities that funding will not be taken away overnight, leaving any work that they have done in limbo.

2.5.3 Conservation of other heating fuels and fuel switching

One challenge with the model of electric and natural gas utilities delivering conservation is that it leaves out some Ontarians. In 2016, roughly 10% of the province's residences were heated by a fuel source that was not electricity or natural gas.[129] These fuel sources, which include wood, as well as GHG-emitting fossil fuels such as propane, heating oil, and coal, are not regulated like the electricity and natural gas industries and homes and businesses using these heating fuels cannot participate in the current suite of utility conservation programs. Natural gas customers served by Kitchener Utilities and Utilities Kingston are also not covered by the current conservation framework and do not have access to the full suite of conservation programs (although both of these utilities do provide some programs).[130]

The government had previously proposed setting conservation targets for other fuels (as part of its consultation on the 2017 Long-Term Energy Plan), but did not follow through with this proposal. The Green Ontario Fund (see the textbox "GreenON: Ontario's experiment with multi-fuel conservation") did offer some conservation programs for other fuels. In particular, the program expanded a home energy retrofit program to customers of other heating fuels (with gas utilities as the delivery agent) and saw relatively high participation from customers using heating oil and propane (see the textbox "Cap and trade funding for home retrofits" in **Chapter 3** of this report). With the wind down of all GreenON programs, there are no longer any specific initiatives aiming to reduce the use of these other fossil fuels used for space heating.

Fuel Switching

The government's draft Environment Plan mentions fuel switching in energy-intensive residences and commercial buildings to cleaner fuel sources such as electricity and other lower carbon fuels where it makes economic sense.[131] It makes sense to implement conservation and fuel switching together – if a switch to a different fuel source is being considered, proper consideration of energy efficiency can help reduce the size and cost of the new heating equipment, and the annual operating costs. However, the current model of conservation being delivered by electric and gas utilities is a poor fit for encouraging fuel switching: converting to the utility's fuel will increase use of that fuel, not decrease it (hence reducing utility performance against conservation targets); converting **away from** the utility's fuel will reduce energy use, but (for gas utilities in particular) may cost the utility a customer.

It makes sense to implement conservation and fuel switching together.

Significant fuel switching to electricity will be needed in the future to meet deep emissions reductions targets (see Q15 of the Environmental Commissioner of Ontario's 2018 Energy Conservation Report "Making Connections: Straight Talk about Electricity in Ontario). Converting to electric heat pumps in homes heated by propane and heating oil makes sense today, from the point of cost savings and environmental benefits (GHG emission reductions). Financial incentives for this were available under the Green Ontario Fund as part of the previous government's Climate Change Action Plan (cancelled as of August 2018), the details of which we see in the textbox "GreenON: Ontario's experiment with multi-fuel conservation". The IESO has already assessed that heat pumps are cost-effective against less-efficient fuel oil, propane and electric baseboard heating, especially when buildings are more energy efficient.[132] At the current time, switching natural gas furnaces and natural gas water heaters to electricity ones is a less feasible option because of the low cost of natural gas compared to electricity; however this type of fuel switching will also be needed in the future.

Both conservation of other fuels and fuel switching may be easiest to address in a single administrator model for conservation, discussed in the next section.

2.5.4 A single administrator model for conservation?

In theory at least, a single administrator model for conservation of all energy sources could deliver all of the potential benefits of gas-electric utility collaboration (e.g., including saving customers' time, effort and money, diversifying program portfolios and reducing program administration costs) while being better able to address conservation of other fuel sources and fuel switching, and prioritizing GHG reductions. There is some evidence that a more coordinated approach to energy conservation drives more energy and GHG emission reductions, saves on administration costs and makes customer participation easier.[133]

A more coordinated approach to energy conservation drives more energy and GHG emission reductions, saves on administration costs and makes customer participation easier.

There is an increasing trend for utility-run conservation frameworks to transition to single "efficiency utilities" with multi-fuel objectives, including GHG emission reductions and integrated multiple funding sources.[134] Vermont, one of the leading U.S. states in energy efficiency, was one of the first major jurisdictions to adopt a third-party model for efficiency programs.[135] Other North American jurisdictions such like Maine, Delaware, NY State and Nova Scotia have also gone the same route[136], with Efficiency Alberta being the

most recent third-party agency delivering energy efficiency programs.

Ontario's GreenON agency, created under the provincial government's now cancelled Climate Change Action Plan was the closest that Ontario came to implementing a multi-fuel single administrator model to deliver energy efficiency and reduce GHGs. However, as the textbox "GreenON: Ontario's experiment with multi-fuel conservation" highlights, GreenON was not truly a single administrator model, and partly duplicated existing utility programs. This meant that, while offering some new initiatives that could not have been launched under utility programs, the execution was somewhat rocky and raised concerns among existing utility conservation program operators.

GreenON: Ontario's experiment with multi-fuel conservation

The Green Ontario Fund (GreenON) was created as an independent GHG reduction agency under the previous provincial government's Climate Change Action Plan. It launched in August 2017 and offered a variety of energy saving measures including the following:[137]

- free smart thermostat program- 150,000 devices were distributed in the first year
- GreenON Industries Program- $200 million dedicated to large-scale demonstration projects to reduce facility and manufacturing emissions
- GreenON rebates program- offered up to $20,000 per project in incentives for residential energy retrofits such as window installations, insulation and heat pumps
- GreenON Social Housing program- $25 million was committed towards social housing of less than 100 units. The Program received applications of over $200 million from 41 social housing providers
- four modern wood heating pilots- launched in northern and Indigenous communities without access to natural gas to replace with more efficient wood stoves
- solar panel installations: rebates worth $90 million in total (announced but not implemented), and
- $300 million GreenON challenge to encourage innovative GHG reduction ideas from businesses.

GreenON was cancelled in June 2018 as part of the cancellation of the province's cap-and-trade legislation. The agency in its short existence offered some benefits to the customers:

- One-window approach to energy efficiency: Residential and business customers could easily access information on a wide range of programs (GreenON and utility conservation programs) through one website and one call centre.
- Expanding energy conservation: Launching programs like the wood heating pilots meant that energy conservation was going beyond electricity and natural gas conservation. Expansion of the home retrofit offering under the Green Investment Fund also offered access to energy efficiency measures to customers on propane/heating oil.
- Enabling fuel switching to cleaner technologies: GreenON provided incentives to move to efficient electric heat pumps/ geothermal from propane or heating oil, which would reduce customer energy use, heating bills and GHG emissions. This type of measure was ineligible for funding under the utility conservation frameworks.

The key word in a single third-party administrator model to deliver energy efficiency is "single".

The key word in a single third-party administrator model to deliver energy efficiency is, of course, "single". However, in Ontario, that was definitely not the case. The launch of a GHG reduction agency when the market already had separate electricity and natural gas conservation programs added another layer of complication and confusion, particularly from the utilities invested in their conservation programs. Some of the concerns raised regarding GreenON include:

- More customer confusion: LDCs and natural gas utilities already had their own separate suites of energy conservation programs, and now a separate entity was offering programs that to a regular customer looked similar to existing ones. While GreenON was publicized as a "one-stop shop" for energy efficiency, it added another layer of confusion for some customers.
- Program duplication: LDCs and natural gas utilities expressed their concerns to the ECO that several programs launched by GreenON were duplicative of existing programs and pilots. The free smart thermostat program, for example, is highlighted in the textbox "LDC-Gas conservation collaboration examples" as a Toronto Hydro- Enbridge pilot. Measures under the GreenON rebates program were also to some degree competing with existing gas and electricity initiatives. The ECO noted that ideally, GreenON programs should target unmet needs and not replace or compete with existing utility programs.[138]
- Cannibalization of utility targets: GreenON programs geared towards reducing GHG emissions also reduced electricity and/or gas consumption, especially those that were duplicative of existing utility programs. Utilities have shared examples with the ECO that businesses and industrial facilities that were ready to participate in CDM/DSM programs (where utilities had invested significant resources in developing projects) ended up participating in GreenON programs instead because of higher incentives.[139] Therefore, GreenON programs were cannibalizing existing CDM and DSM programs and utilities were losing out on savings to meet their framework targets.
- Savings attribution: With similar programs in the market that contributed to energy savings and GHG reductions being marketed by more than one provider/agency, attributing or giving credit to a utility or to GreenON for energy and GHG savings became an issue. The IESO retained Navigant to develop recommendations for allocating costs and attributing savings in early 2018, but this process was started after GreenON had already been in the market for six months. The ECO underlined several concerns in its response to Navigant during the consultation, including the fact that GreenON funding should not be counted towards energy utility program results and there should be accountability that any incremental GreenON funding is actually leading to GHG reductions.[140] There was also the risk of double-counting when energy conservation activities led to GHG reductions, primarily for natural gas conservation programs.[141] With the cancellation of GreenON, a final paper with a preferred attribution approach was never published by the IESO.
- Lack of coordination with utilities: During the existence of GreenON, both gas and electricity utilities indicated to the ECO that despite making several proposals and presenting business plans that showed how GreenON programs could better leverage existing utility conservation resources, GreenON did not take advantage of existing conservation resources available.[142] GreenON issued its own Request for Proposals and delivered several of the programs through the IESO and the Ontario Centres of Excellence. This potentially created another layer of confusion for contractors and higher delivery costs.

If Ontario is to gain the benefits of a single efficiency utility, it will be important to minimize disruption in the industry and for the customers. Some of the key elements could include:

- Transition plan: An abrupt move from one model to another will create uncertainty on all fronts. Vermont, often cited as an example of a jurisdiction that underwent a well-managed transition, took three years to completely move over to the single administrator model.[143] The transition plan will require the proper authority, adequate funds and a strict but appropriate timeline to move over to the new framework.

An abrupt move from one model to another will create uncertainty on all fronts.

- Timing: Regardless of how robust the transition plan is, timing of its execution is key so that there is sufficient time for all relevant parties to move over to the new model. With the current CFF and DSM frameworks concluding on December 31, 2020, discussions will be beginning shortly on the next energy efficiency frameworks. This might the opportune time for government to consult on the single administrator model.
- Testing: Before Wisconsin decided in 2001 to transition from utility-run conservation to a single state-run model for gas and electricity conservation programs, it ran a pilot program in 1998 in northeast Wisconsin.[144] The pilot tested the idea of a single-administrator model where contractors separate from the utilities delivered programs and ads were run for programs that offered cross-fuel savings. Subsequent market research and analysis allowed Wisconsin Focus on Energy to focus on the right messages and the right initiatives when it launched.[145]
- Extensive consultation: The government will need buy in from a vast range of stakeholders to make such a drastic shift in the design and delivery of conservation. When the government of Alberta established Efficiency Alberta, it struck up a panel of experts who consulted with a cross-section of Albertans including residents, businesses, Indigenous communities, municipalities and industry stakeholders. The engagement process gathered information on existing barriers to energy efficiency, on the types of technologies to adopt and how best to measure success.[146] The panel held consultations over four months including several open houses, technical sessions, municipal sessions and sessions with Indigenous communities. After the consultation, the panel released a report that set out the vision and outcomes of Efficiency Alberta so that there was transparency towards all parties and to regular citizens. As mentioned earlier, the timing may be right now for the province to start having such a conversation. Previous consultations for conservation frameworks have been rather narrow in scope. A drastic change in framework will require an extensive stakeholder process that engages the broader public, and should include use of the Environmental Registry. Implementing some of the best practices from the Alberta process might be the way to go if Ontario is considering a single administrator model.

The government will need buy in from a vast range of stakeholders.

- Establishing key policy objectives: The government must establish and determine an appropriate balance between key policy objectives, e.g., maximizing targets (reductions in electricity, gas and GHG emissions), minimizing costs, broad customer inclusion through programs, overcoming market barriers and encouraging innovation in energy efficiency, amongst others.
- Continuation and enhancement of programs: Successful programs that have seen significant savings such as the Conservation First Framework Retrofit Program and the Demand Side Management Home Weatherization Program should continue in

some form under the new framework. With one administrator, some electricity and gas programs could be merged and enhanced into one offering for the customer, possibly driving more participation.

- Evaluation of savings: Independent evaluation of results from all fuels should continue as that will be a clear indication of the success of the model.
- Regulatory changes: The province will need to make extensive regulatory and policy changes to transition from the current model to establish the new entity and also to establish /amend oversight responsibilities for such an entity. Successful energy administrators have excelled under supportive and robust laws and policy structures that have created long-term certainty, e.g. through a franchise model[147], which also means independence from political decisions. There might also be a need to amend regulations to establish how the framework will be funded, e.g, through the rate base, the tax base, or some combination.
- Industry support: This undoubtedly will be the toughest hill to climb if Ontario moves to a single-administrator model. LDCs and gas companies have successfully delivered conservation programs for years and have the established customer relationships, as well as much of the technical expertise. Similar to the Vermont model,[148] electricity and natural gas companies could bid into requests for proposals to deliver energy efficiency under the single administrator model in their own jurisdictions and in other jurisdictions. The extensive knowledge and skill sets developed by the utilities must be utilized in the consultation process to develop this framework. It will be important to partner with both electricity and gas utilities from the onset of this consultation to get their buy in and to assure them that they will have the opportunity to still deliver energy efficiency, albeit under a different model.

The textbox "Single Administrator Models in other jurisdictions" reviews two existing single administrator models, one that is often lauded as the pioneer in this field, while the other is one of the newest entrants.

Single Administrator Models in other jurisdictions

Efficiency Vermont

Vermont was the first state to create a statewide "energy efficiency utility" in the form of Efficiency Vermont in 2000.[149] Under Vermont's current 12-year franchise model, Efficiency Vermont and the smaller Burlington Electric Department deliver electricity and unregulated heating and processing fuel energy efficiency services to homes and businesses.[150] To ensure that energy efficiency is "fuel blind" in nature, state statute has established that energy service providers must deliver whole building and process heat efficiency regardless of fuels, facilitate fuel switching where appropriate and promote electricity and other fuel efficiency across all customers.[151]

Historically, electricity utilities were the face of energy efficiency programs in Vermont but this system did not work well. Investor owned utilities found it difficult to promote programs that would reduce their revenues; also, there were administrative inefficiencies with 22 utilities delivering programs.[152] In 1999, the state established one energy efficiency utility (EEU) to provide energy efficiency to all Vermonters. Initially, Efficiency Vermont and its fiscal and contractor agents had a short-term contract with the state Commission to design, deliver and fund programs. In 2009, the structure moved to a more long-term order of appointment or franchise model which added more stability to the programs.[153] This has also given Efficiency Vermont more responsibility and oversight to design long-term energy efficiency. Along with transparent public proceedings on its results, the Commission also undertakes a comprehensive review of the EEU every 6 years.

In 1999, the Vermont Public Service Board was authorized to start collecting a volumetric Energy Efficiency Charge (EEC) from electricity and natural

gas ratepayers. In 2018, residential electricity customers paid 1.4 cents per kWh for energy efficiency[154], while gas customers paid 5 cents per CCF (100 cubic feet).[155] The programs for reducing fuel use such as heating oil and propane are funded from the Regional Greenhouse Gas Initiative (RGGI) auction proceeds and from the New England Forward Capacity Market.[156]

Under this structure, utilities do not have a role in delivering conservation measures. A single non-utility contractor that has a multi-year performance-based contract with Vermont's Public Sector Board (PSB) undertakes program design and delivery. Utilities were relieved of their obligation to deliver conservation programs during the settlement process to create Efficiency Vermont.[157] Utilities refer customers seeking energy efficiency programs to Efficiency Vermont and also provide full electronic customer identification and consumption records to the EEU so that it can maintain the energy use database and also track savings[158].

Efficiency Alberta

Efficiency Alberta is one of the newest energy efficiency delivery administrators in North America, established as a not-for-profit Crown Corporation under Alberta's Energy Efficiency Act.[159] Its role is to educate customers about energy use, design and deliver energy efficiency programs, help develop micro-generation and small scale renewable energy systems and to promote the development of an energy efficiency services industry in the province. As mentioned earlier, an Energy Efficiency Advisory Panel undertook an extensive consultation to receive input from all Albertans before putting forward final recommendations on the Efficiency Alberta framework. The panel also reviewed other jurisdictions such as Efficiency One in Nova Scotia and the Energy Trust of Oregon to understand best practices.

Dunsky Energy Consulting were retained to design the first suite of programs with cost and savings estimates (energy and GHG). Its report set the first-year budget at $43.3 million and a target of 594,300 gigajoules of annual energy savings and 682,300 tons of CO_2e in lifetime GHG reductions.[160]

The first programs launched in early 2017 and now include but are not limited to the following:[161]

- Residential No-Charge Energy Savings Program which include LED lighting products, high-efficiency shower heads, faucet aerators and a smart thermostat
- Residential Retail Program which included online rebates for home improvements and instant savings
- Business, Non-profit and Institutional Energy Savings Program which offers incentives up to $25,000 per facility to install high-efficiency products
- Residential and Commercial Solar Program offers a maximum payable incentive and a $/watt incentive for solar installations
- Custom Energy Solutions which offers a tailored approach to businesses to reduce operating costs and reduce energy use, and
- Indigenous Green Loan Guarantee, which funds the development of large-scale renewable electricity generation, projects in Indigenous communities. $50 million in Green Loan Guarantees are currently available.

The Government of Alberta funds Efficiency Alberta through its carbon tax. The province has earmarked $645 million in its 2016-2017 budget for spending on Efficiency Alberta over the next 5 years.

Successfully establishing and administering a single administrator model is not easy. Jurisdictions like Vermont took almost a decade to get it right. In many cases, lack of independence from the government has affected operations and funding. Some of the key requirements of a single administrator of energy efficiency should include:

- long-term commitment to funding
- recognition that energy efficiency is a resource on par with traditional energy resources
- independence from government and other agencies so that there are no abrupt changes or interruptions to its operations
- stability of appointment such as through a franchise model (see the textbox: "Single Administrator Models in other jurisdictions"), and
- accountability for performance to ensure it is driving energy savings and reducing GHG emissions.

2.6. Conclusion

Utility-run energy conservation programs have delivered multiple benefits for Ontario, and can do even more. But the current model of utility delivery of conservation programs has key gaps, regarding coordination of natural gas and electricity conservation, coverage of other fuels, fuel switching, and a lack of clarity on the overall objectives of conservation programs.

A conservation framework that integrates electricity and natural gas conservation programs and brings in conservation of other fuels could lead to lower costs to deliver conservation while increasing the potential for energy and GHG savings, and expand the ability of more Ontarians to make their lives more comfortable.

A single administrator model for conservation of all energy sources used in buildings might help achieve these objectives. If a single administrator model is to be considered, then the discussions with key stakeholders must begin now. Along with those discussions, there must be long-term commitment to fund conservation programs with an appropriate stable funding mechanism to encourage this shift, and conservation programs for non-regulated fuels need to be designed and delivered alongside regulated fuel conservation. More importantly, the necessary regulatory and policy changes will need to amended and strengthened to ensure that the single administrator can be established and implemented successfully.

The ECO recommends that the Ministry of Energy, Northern Development and Mines prepare a post-2020 energy conservation program framework to deliver its planned 3.2 Mt CO_2e of greenhouse gas reductions from conservation programs by:

- **growing natural gas conservation funded by ratepayers, while looking at ways for more natural gas customers to benefit, such as expanding participation in programs, and using conservation to avoid infrastructure investments**
- **including conservation of other heating fuels and fuel switching**
- **focusing electricity conservation on programs that save electricity during hours of high demand, when fossil fuels are being used to generate electricity**
- **accurately measuring and valuing GHG reductions, including valuing the benefits of emissions reductions in cost-effectiveness testing (using up-to-date inputs), and making greenhouse gas reductions a performance metric for utilities or other conservation providers, and**
- **assessing whether a single administrator model for conservation of all energy sources is a preferred model to achieve these objectives.**

Endnotes

1. For more information see section C.3 in **Appendix C** of this report.
2. For natural gas utilities, the OEB approves the rate that they can charge on the natural gas rate base to cover the cost of delivering conservation programs. On the other hand, the IESO determined the current budget for the electricity conservation programs based on government direction and achievable potential studies completed at the time. Actual spending (which cannot exceed the budget limit) is added to the electricity rate base and charged to all electricity customers.
3. Electricity conservation programs were first introduced by Ontario Hydro in the early 80s, which at the time was the only major transmitter and distributor of electricity in Ontario, and was responsible for regulating over 300 municipally owned distribution utilities. Conservation efforts were abandoned in the 90s as the then government's priorities shifted to keeping electricity bills down. A province-wide framework to pursue electricity conservation was only re-established after the 2003 election, in which all parties pledged to close the coal-fired power plants and pursue conservation to improve the province's poor power reliability. For the gas utilities, energy conservation programs are generally described as "demand side management" (DSM). The two main natural gas delivery companies, Enbridge Gas Distribution and Union Gas Limited, have filed DSM plans with the OEB since 1995, offering a range of programs to the majority of their customers.
4. $1.8 billion for LDCs+ $0.8 billion for the IESO central services, over the six-year period.
5. The total amended budget for IAP is $280 million over 6 years.
6. Independent Electricity System Operator, information provided to the ECO (12 January 2018).
7. The total revenue of Enbridge and Union Gas in 2017 was $5.534 billion. For more information see: Ontario Energy Board, 2017 Yearbook of Natural Gas Distributors (Toronto: OEB, August 2018) at 6.
8. "Price Overview", online: Independent Electricity System Operator <www.ieso.ca/power-data/price-overview/global-adjustment>. [Accessed 14 February 2019]
9. Ontario Energy Board, EB-2014-0434 Report of the Board: Demand Side Management Framework for Natural Gas Distributors (2015-2020) (Toronto: OEB, December 2014) at 17.
10. Savings methodologies are detailed in **Appendices C** and **D** of this report (available online).
11. 2015-2020 IESO-LDC Energy Conservation Agreement (2014), article 4 at 6-7.
12. Ontario Energy Board, EB-2014-0434 Report of the Board: Demand Side Management Framework for Natural Gas Distributors (2015-2020) (Toronto: OEB, December 2014) at Appendix A.
13. 2015-2020 IESO-LDC Energy Conservation Agreement (2014), article 5.4 at 10-11.
14. "About Public Appeals", online: Independent Electricity System Operator <www.ieso.ca/en/Corporate-IESO/Media/About-Public-Appeals>. [Accessed 14 February 2019]
15. Independent Electricity System Operator, information provided to the ECO (8 August 2018).
16. 9,358,170,026 kWh net 2017 annual energy savings at the generator level = 8,731,172,635 kWh net 2017 annual energy savings at the distribution system end-user level / 9,000 kWh average home annual energy consumption at the distribution system end-user level = 970,130 homes for one year. Source: Independent Electricity System Operator, information provided to the ECO (25 February 2019).
17. Total electricity demand in the province in 2017 was 131.83 TWh. See: "Year End Data 2017", online: Independent Electricity System Operator <www.ieso.ca/Corporate-IESO/Media/Year-End-Data/2017>. [Accessed 14 February 2019]
18. There are electricity consumption and demand reductions from codes and standards that make buildings and appliances more energy efficient, There are also savings associated with "other" conservation initiatives such as gas conservation and federal conservation programs.
19. Ibid.
20. See **Appendix D**, Table D.1 of this report. This is likely a slight underestimate as some program activity before 2007 is still delivering savings today.
21. 1.7 billion m^3 of persistent natural gas savings divided by the average natural gas consumption in a home at 2400 m^3.
22. Directive from the Minister of Energy to the Independent Electricity System Operator re: Amending March 31, 2014 Direction regarding 2015-2020 Conservation First Framework (23 October 2014).
23. Independent Electricity System Operator, information provided to the ECO (15 January 2019).
24. This includes LDC delivered conservation and the IESO delivered Industrial Accelerator Program. Source: Independent Electricity System Operator, information provided to the ECO (15 January 2019).
25. Ontario Energy Board, 2016 Natural Gas Demand-Side Management Annual Verification by DNV-GL (Toronto: OEB, October 2018) at 4.
26. Toronto Hydro-Electric System Ltd, Custom Incentive Rate-Setting Application for 2020-2024 Electricity Distribution Rates and Charges, Ontario Energy Board EB-2018-0165 (Toronto: THESL, August 2018), Exhibit 1B, Tab 5 at 11.
27. Ibid.
28. Ibid at Exhibit 2B, Section E7.4 at 2.
29. Ibid at Exhibit B, Section E7.4 at 18.
30. Ibid at Exhibit 2B, Section B, Appendix E at 68.
31. Unlike the electricity system, natural gas is purchased in the broader North American market; so cost savings from avoiding having to bring new wells into production are not fully captured by Ontario customers.
32. Lake Shore Gold, Information provided to the ECO (5 February 2019).
33. Enbridge Gas Distribution Inc., information provided to the ECO (13 December 2018).
34. Letter from Thomas Lambert, Manager of Employment &Training/ Economic Development of Nipissing First Nation to Union Gas (16 July 2018).
35. Ibid.
36. Enbridge Gas Distribution Inc., information provided to the ECO (13 December 2018).
37. "2018 Electricity Data", online: Independent Electricity System Operator <www.ieso.ca/en/Corporate-IESO/Media/Year-End-Data>. [Accessed 14 February 2019]
38. Enbridge persistent gas savings 623.8 million m^3, Union Gas persistent gas savings 1100.76 million m^3. An emissions factor of 1.899 kg CO_2e/ m^3 of natural gas is used.

39. For more information, see Environmental Commissioner of Ontario, Making Connections: Straight Talk about Electricity in Ontario, 2018 Energy Conservation Progress Report, Volume One (Toronto: ECO, April 2018) at 309.

40. Environmental Commissioner of Ontario, Making Connections: Straight Talk About Electricity in Ontario, 2018 Energy Conservation Progress Report, Volume One (Toronto: ECO, April 2018) at 170-172.

41. The estimate of 6.5 Mt CO_2e includes the combined contributions of conservation programs (6.1 TWh), codes and standards (4.2 TWh) and renewable generation (13.5 TWh). Assuming each component reduced emissions in proportion to its share of electricity, the impact of conservation programs alone would be 1.6 Mt CO_2e. However, by the end of 2017, savings from conservation programs were higher (9.4 TWh) due to two more years of program activity. Assuming these additional savings delivered emissions reductions in the same proportion leads to an estimate of 2.6 Mt CO_2e emissions reductions from conservation programs through 2017.

42. Ontario Energy Board, Mid-Term Review of the Demand-Side Management (DSM) Framework for Natural Gas Distributors (2015-2020), EB-2017-0127/0128 (Toronto: OEB, November 2019) at 6.

43. Ministry of Energy, Northern Development and Mines, information provided to the ECO (15 January 2019).

44. Ibid.

45. Independent Electricity System Operator, information provided to the ECO (31 January 2018).

46. An Ontario Energy Association white paper presented over $120 million of potential savings but no recommendations have been put forward formally by the IESO. For more information see: Ontario Energy Association, Reforming Conservation: Building a Better Framework (Toronto: OEA, December 2018).

47. Ministry of Energy, Northern Development and Mines, information provided to the ECO (15 January 2019).

48. Ibid.

49. Independent Electricity System Operator, "2018 Technical Planning Conference" (presentation, 13 September 2018), slide 20.

50. Ibid at 50, 51.

51. "The Fair Hydro Act, 2017", online: Ontario Energy Board <www.oeb.ca/newsroom/2017/fair-hydro-act-2017>. [Accessed 22 February 2019]

52. "Settlements: Variance Account Under Ontario's Fair Hydro Plan ($M)", online: Independent Electricity System Operator <www.ieso.ca/en/Sector-Participants/Settlements/Global-Adjustment-for-Class-B>. The variance for 2018 was $2540 million. [Accessed March 5, 2019]

53. CO_2e or carbon dioxide equivalent is a measure used to compare the emissions from various greenhouse gases based upon their global warming potential. For more information see: "Carbon Dioxide Equivalent", online: OECD <stats.oecd.org/glossary/detail.asp?ID=285>. [Accessed 21 February 2019]

54. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan (Toronto: Queen's Printer, October 2018)at 23.

55. Ibid at 32.

56. Ministry of Energy, Northern Development and Mines, information provided to the ECO (15 January 2019).

57. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan (Toronto: Queen's Printer, October 2018) at 24.

58. Ibid at 23.

59. "2018 Electricity Data", online: Independent Electricity System Operator <www.ieso.ca/en/Corporate-IESO/Media/Year-End-Data>. [Accessed 14 February 2019]

60. Enbridge's budget is now $60 million/year and Union Gas' budget is at $57 million/year.

61. Enbridge Gas Distribution Inc., 2018 Cap and Trade Compliance Plan Application, OEB EB-2017-0224 (Toronto: EGD, January 2018),Transcript vol. 3, p. 133, lns. 5-9.

62. "Ford Government to help expand access to natural gas", online: Ontario Newsroom <news.ontario.ca/opo/en/2018/09/ford-government-to-help-expand-access-to-natural-gas.html>. [Accessed 6 March 2019]

63. The OEB agrees that all material benefits of DSM should be recognized as part of the screening and cost-effectiveness analyses. As such, the OEB agrees that the cost of carbon should be added to the TRC-Plus cost effectiveness test. This will ensure that planning and cost-effectiveness analyses fully consider the costs and benefits of the DSM programs. The natural gas utilities should include the federal cost of carbon as part of future avoided cost updates, as it is the most relevant public data source currently available. The OEB will also include the cost of carbon in the cost-effectiveness analysis undertaken as part of the annual program evaluation work. Additionally, the OEB will maintain the non-energy benefit adder of 15% currently included in the TRC-Plus cost-effectiveness test. The OEB will further consider this topic as part of the post-2020 DSM framework development. Source: Ontario Energy Board, Mid-Term Review of the Demand Side Management Framework for Natural Gas Distributors, EB- 2017-0127 and 0128 (Toronto: OEB, November 2018) at 6.

64. An achievable potential study (APS) is one way to assess how much of a fuel or an energy use conservation programs can reduce. The study usually considers the following elements:
- Current availability of conservation programs
- Existing budget
- Current participation rates
- Financial incentives on offer
- Determination of a range of energy efficiency measures and their related consumption
- Costs and savings across customer sectors, and
- Cross-jurisdictional studies.

65. While there are many variations and terminology, the more commonly used potential studies are the following:
- Technical potential: this is considered as the maximum potential of a jurisdiction, estimating the savings potential from all technically feasible energy efficiency measures implemented at their full market potential.
- Economic potential: this is a subset of the technical potential, which considers the maximum potential when all economically feasible (i.e. cost-effective) energy efficiency measures are implemented. Different methodologies may be used to calculate cost-effectiveness.
- Unconstrained achievable potential: a subset of the economic potential, this level estimates conservation savings of all economically feasible and existing measures based on achievable cost curves and without any budgetary or policy constraints.
- Constrained achievable potential: this is part of the unconstrained potential, as it assumes that budgets stay at their current levels.

66. Ministry of Energy, Northern Development and Mines, information provided to the ECO (15 January 2019). The 3.2 Mt CO_2e of GHG reductions by 2030 is the "sum of the difference in rate of change (million m^3/year) between the constrained and unconstrained potential scenarios presented in the OEB's 2016 Natural Gas Achievable Potential Study". However, the Ministry also stated that the baseline does not explicitly include current levels of natural gas demand- side management programs, which appears incompatible with the previous statement. A check of the Achievable Potential study confirms that the math works out, showing 3.3 Mt CO_2e in potential savings:

Table comparing the Unconstrained and Constrained Achievable Potentials.

Year	GHG savings from Constrained Achievable Potential*	GHG savings from Unconstrained Achievable Potential*	Difference	Cost of delivering Constrained Achievable Potential	Cost of delivering Unconstrained Achievable Potential	Difference
2020**	2.2 Mt CO_2e	3.5 Mt CO_2e	1.3 Mt CO_2e	$111 million/year	$550 million/ year	$439 million/year
2030	4.7 Mt CO_2e	9.3 Mt CO_2e	4.6 Mt CO_2e	$120 million/year	$722 million/year	$602 million/year
2030 - 2020	2.5 Mt CO_2e	5.8 Mt CO_2e	3.3 Mt CO_2e			

Note*: the OEB's APS presents the GHG savings in million m^3, the numbers have been converted to Mt to be consistent with previous climate change reports released by the ECO.

Note**: the APS projects conservation savings from 2015 to 2030, but the ECO is only using the numbers starting in 2020 since the government's environment plan has a starting date of 2021.

67. Ontario Energy Board, Final Report: Natural Gas Conservation Potential Study by ICF International (Toronto: OEB, July 2016) at 5. Also, see Table in endnote 74.

68. Ontario Energy Board, Final Report: Natural Gas Conservation Potential Study by ICF International (Toronto: OEB, July 2016) at 13 (section 2.8.3).

69. "IESO announces Results of Demand Response Auction", online: Independent Electricity System Operator <www.ieso.ca/en/Sector-Participants/IESO-News/2018/12/IESO-Announces-Results-of-Demand-Response-Auction>. [Accessed 14 February 2019]

70. Directive from the Ontario Minister of Energy to the Ontario Energy Board (31 March 2014).

71. Letter from the Ontario Energy Board to the Natural Gas Distributors re: DSM Mid-Term Review (20 June 2017).

72. Ontario Energy Board, Demand Side Management Framework for Natural Gas Distributors (2015-2020) (Toronto: OEB, December 2014) at 36.

73. Ontario Energy Board, Final Report: Natural Gas Conservation Potential Study by ICF International (Toronto: OEB, July 2016) at 3.

74. Ibid.

75. Ibid at 4.

76. ICF's report to the OEB highlights some of the current barriers in the industry, including the following:
• There is currently no precedent or evidence of gas utilities benefitting from incorporating DSM into long-term planning- only one North American utility is planning to pilot such a geo-specific study.
• Current DSM programs are mostly focused on reducing overall consumption and not peak consumption, which is often the main driver for new infrastructure.
• Lack of metered data (like smart meters in electricity) makes it difficult for gas utilities to measure the impact of DSM on peak demand and are therefore not reliable enough to be considered as an alternative to new infrastructure.
• ICF's research indicated that gas infrastructure costs are usually less than electricity infrastructure costs, and therefore have less impact on the customers' bills.
• The electricity system structure, which is built for instant peaks vs. gas, which is built to meet daily requirements, makes demand response a more feasible alternative for the electricity system. Without the proper infrastructure, gas utilities will not have the assets to handle a reliability issue and an outage in the natural gas system takes much longer to bring back online compared to electricity.
• DSM planning and infrastructure planning would need to be timed so that the DSM program is running and has produced results with a certain level of reliability (2-4 years) for the utility to reconsider the need for new planned infrastructure. However, the utility may not know 2 to 4 years ahead of time if it actually needs to build new assets for them to implement a DSM program instead ahead of time.
• DSM programs may not be a useful alternative to new construction in a new community.
• Geo-specific or regional DSM programs may benefit a small section of the population at the expense of the rest of the rate base.
• The current short timeframe of the DSM framework is not favourable to DSM being incorporated into IRP regional planning.

77. Ontario Energy Board, Final Report: Natural Gas Conservation Potential Study by ICF International (Toronto: OEB, July 2016) at 42.

78. Enbridge Gas Distribution, EB-2017-0127/0128- DSM Mid-Term Review, Submission to Ontario Energy Board (Toronto: EGD, January 2018), Appendix E at 8.

79. Ibid.

80. Ontario Energy Board, Mid-Term Review of the Demand Side Management Framework for Natural Gas Distributors, EB-2017-0127/0128 (Toronto: OEB, November 2018) at 20.

81. Ministry of the Environment, Conservation and Parks, information provided to the ECO (4 February 2019).

82. For more information see: Environmental Commissioner of Ontario, Making Connections: Straight Talk About Electricity in Ontario, 2018 Energy Conservation Progress Report, Volume One (Toronto: ECO, April 2018) at 312.

83. Summer peak period is defined as weekdays from 11 am to 5 pm in June through September; shoulder off-peak period is all weekend hours and weekday hours from 10 pm to 7am in April, May, October, and November. Source: Independent Electricity System Operator, information provided to the ECO (8 August 2018).

84. Directive from the Minister of Energy to the Independent Electricity System Operator re: Amending March 31, 2014 Direction regarding 2015-2020 Conservation First Framework (23 October 2014).

85. Research done by a consultant during the IESO's Mid-Term Review process concluded that the current 15% adder might be too conservative as non-GHG benefits from conservation programs (e.g. improved comfort) may be around that much on their own.

86. Ministry of Energy, Northern Development and Mines, information provided to the ECO (15 January 2019).

87. Independent Electricity System Operator, information provided to the ECO (8 August 2018).

88. In some jurisdictions, the cost of GHG emissions are already internalized in the TRC and PAC calculations. In others, when GHG and other non-energy benefits are added on, it is termed a societal cost test and not a TRC. Jurisdictions such as Massachusetts have gone with this definition.

89. The value assigned to greenhouse gas emissions reductions is a policy choice. It could be based on the estimated societal benefit in terms of avoided climate impact, or on the current market value of the emissions reductions, based on the relevant carbon pricing framework in effect. The Ministry of the Environment and Climate Change had originally proposed a carbon price of $43 which the IESO was taking into consideration as part of the Midterm Review. Source: Independent Electricity System Operator, information provided to the ECO (1 December 2017 and 12 January 2018). With the cancellation of Ontario's cap and trade program and its replacement by federal carbon pricing, the market value of emissions reductions has also changed.

90. Independent Electricity System Operator, information provided to the ECO (15 January 2019).

91. A similar methodology was proposed in The Atmospheric Fund, A Clearer View of Ontario's Emissions: Practical Guidelines for Electricity Emissions Factors (Toronto: TAF, July 2017) at 11.

92. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at v.

93. Ibid at 1.

94. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at 24.

95. Independent Electricity System Operator, Conservation Framework Mid-Term Review: Final Report by Navigant (Toronto: IESO, March 2018) at 113-114.

96. Enbridge and Toronto Hydro may extend the program- program is offered on a year to year basis.

97. Toronto Hydro, Information provided to the ECO (21 September 2018).

98. Ibid.

99. "Energy Conservation Program", online: Niagara Peninsula Energy Inc. <www.npei.ca/conservation/energy-concierge-program>. [Accessed 6 March 2019]

100. Ibid.

101. Independent Electricity System Operator, 2017 Program Evaluation: Niagara Peninsula Energy Inc. Hotel. Motel Pilot by Nexant and NMR Group Inc. (Toronto: IESO, November 2018) at 4.

102. Independent Electricity System Operator, Whole Home Pilot Evaluation by Cadmus (Toronto: IESO, November 2018 at 8).

103. Independent Electricity System Operator, information provided to the ECO (15 January 2019).

104. Independent Electricity System Operator, Whole Home Pilot Evaluation by Cadmus (Toronto: IESO, November 2018) at 13.

105. Independent Electricity System Operator, information provided to the ECO (8 August 2018).

106. Independent Electricity System Operator, Whole Home Pilot Evaluation by Cadmus (Toronto: IESO, November 2018) at 8.

107. Ibid.

108. Ibid.

109. Independent Electricity System Operator, "Conservation Framework Mid-Term Review: Collaboration" (presentation by Navigant, 27 April 2017), slide 18.

110. LDCs and energy service providers, information provided to the ECO (June-August 2018).

111. Ibid.

112. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at 128-136.

113. American Electric Power Ohio, EfficiencyCrafted Homes Program: 2017 Evaluation Report by Navigant Consulting (Chicago: AEP Ohio, April 2018) at 10.

114. Ibid

115. Ibid at 16.

116. Ibid at 17.

117. American Electric Power Ohio, 2017 Portfolio Status Report of Energy Efficiency and Peak DR Programs Vol I by Navigant Consulting (Chicago: AEP Ohio, April 2018) at 12 and 20.

118. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at 104.

119. Ibid at 105.

120. "LADWP Helps Thousands of LA Businesses Save Energy and Water", online: LADWP <www.ladwpnews.com/ladwp-helps-thousands-of-la-businesses-save-energy-and-water/>. [Accessed 6 March 2019]

121. Ibid.

122. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at 102.

123. Ibid at 104.

124. Ibid.

125. Southern California Gas, "Come Together: Turning Utility Collaboration into a Strategic Energy and Water Efficiency Resource" (Presentation at the 2017 ACEEE National Conference on Energy Efficiency as a Resource, 1 November 2017), slide 7.

126. Ibid.

127. 1 Therm is equal to 105.5 megajoules or 29.3 kWh or 2.83 cubic meters. Source: <www.kylesconverter.com/energy,-work,-and-heat/gigawatt-hours-to-therms-(uk)>. [Accessed 6 March 2019]

128. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at iv.

129. 2016 Natural Resources Canada Comprehensive Energy Use Database Residential Sector Table 14. These other sources include heating oil, propane, coal and wood.

130. These customers though have access to Conservation First electricity CDM programs through their respective LDCs.

131. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan (Toronto: Queen's Printer, October 2018) at 24.

132. Cold climate electric heat pumps have payback periods of less than 5 years compared to fuel oil or baseboard heating. Source: Independent Electricity System Operator, An Examination of the Opportunity for Residential Heat Pumps in Ontario (Toronto: IESO, 6 March 2017) at 19.

133. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at 1-4

134. American Council for an Energy-Efficient Economy, Nobody's Perfect: Choosing (and Improving) Models for Program Administration by Dunsky Energy Consulting (Washington DC: ACEEE, 2010) at 5-74.

135. Ibid at 5-81.

136. Ibid.

137. Environmental Commissioner of Ontario, Climate Action in Ontario: What's Next? (Toronto: ECO, September 2018) at 222-224.

138. Letter from the Environmental Commissioner of Ontario to Navigant Consulting re: Navigant's attribution concept paper (5 June 2018) at 2.

139. Local distribution company, Information provided to ECO (June 2018).

140. Letter from the Environmental Commissioner of Ontario to Navigant Consulting re: Navigant's attribution concept paper (5 June 2018) at 2.

141. Ibid.

142. Local distribution companies and natural gas utilities, Information provided to the ECO (June-August 2018).

143. American Council for an Energy-Efficient Economy, Taking the Efficient Energy Model to the Next Level by Vermont Energy Investment Corporation (Washington DC: ACEEE, August 2008) at 10.

144. Wisconsin Energy Conservation Corporation, Says Who? Transitioning from Utility to Third-Party Energy Efficiency Information Sources (Milwaukee: WECC) at 3.

145. Ibid at 6.

146. Alberta Energy Efficiency Advisory Panel, Getting it Right: A More Energy Efficient Alberta (Calgary: EEAP, 2016) at 19.

147. American Council for an Energy-Efficient Economy, Taking the Efficient Energy Model to the Next Level by Vermont Energy Investment Corporation (Washington DC: ACEEE, August 2008) at 9.

148. "State and Local Policy Database", online: American Council for an Energy-Efficient Economy <database.aceee.org/state/vermont>. [Accessed 6 March 2019]

149. Ibid.

150. It is important to note that Vermont lacks natural gas mains and natural gas service throughout the state. Therefore, heating fuels include fuel oil, propane, wood and electricity. . Source: American Council for an Energy Efficient Environment, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at 14.

151. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014) at 14.

152. "History and Structure", online: State of Vermont Public Utility Commission <puc.vermont.gov/energy-efficiency-utility-program/history-and-structure>. [Accessed 6 March 2019]

153. Ibid.

154. "2018 electric EEE rates", online: State of Vermont Public Utilities Commission <puc.vermont.gov/sites/psbnew/files/doc_library/AttachmentToOrderRe2018EECRates.pdf>. [Accessed 6 March 2019]

155. "Residential Rates" online: Vermont Gas <www.vermontgas.com/account/rates/>. [Accessed 6 March 2019]

156. American Council for an Energy-Efficient Economy, Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs by Nowak S. et al (Washington DC: ACEEE, August 2014)at 15.

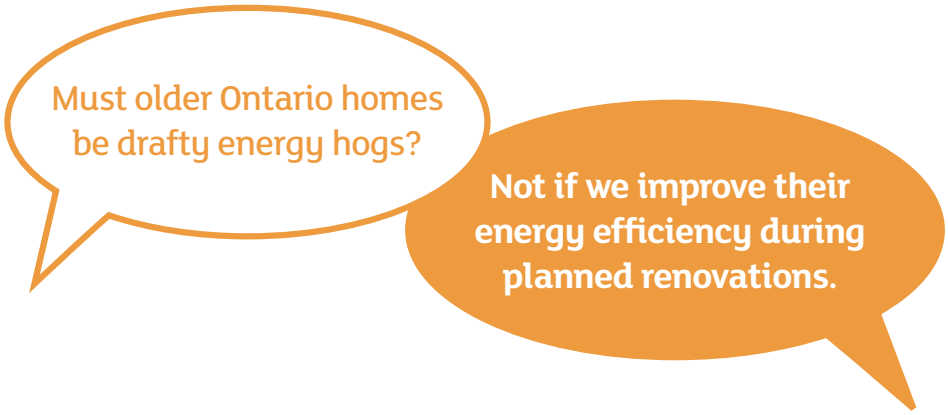
157. American Council for an Energy-Efficient Economy, Gauging Success of the Nation's First Efficiency Utility: Efficiency Vermont's First Two Years by Efficiency Vermont and Optimal Energy Inc. (Washington DC: ACEEE) at 2.

158. Ibid at 8.

159. Alberta Energy Efficiency Advisory Panel, Getting it Right: A More Energy Efficient Alberta (Calgary: EEAP, 2016) at 15.

160. Alberta Climate Change Office, Alberta Energy Efficiency Program Design: Phase 2 Final Report by Dunsky Energy Consulting (Calgary: Alberta Climate Change Office, March 2017) at 6.

161. "Who We Are", online: Energy Efficiency Alberta <www.efficiencyalberta.ca/about-us/our-history/>. [Accessed 6 March 2019]



3. Older homes: the renovation opportunity

Abstract

Older Ontario buildings use unnecessarily large amounts of energy, mostly fossil fuels. This is especially true for one important group of older Ontario buildings - existing low-rise homes. The 85% of Ontario homes built in or before 2005 use at least twice as much energy (as modelled) as those of the same size built today.

Slashing the energy needed in existing homes can make them more comfortable and more resilient, lower utility bills, and increase resale values, while growing the renovation economy and reducing climate pollution. Most people would prefer homes that are draft-free, warm in the winter and cool in the summer, and inexpensive to keep that way. Every Ontario home has the potential to be like that, but most are not.

Ontario's energy conservation programs and efficiency standards have led to some improvements in existing buildings, especially in their lighting, furnaces, and air conditioners. But deep energy efficiency, to make buildings more than 30% more efficient, can typically be achieved only by improving the building envelope: its walls, roof, floor, doors and windows. To date, Ontario conservation programs have done little to improve building envelopes in existing homes, yet serious progress in reducing their energy use and climate impact is not possible without taking this step.

Ontario misses a crucial opportunity when energy efficiency is left out during renovations. Ontarians love to renovate their homes; an estimated one-third of dwellings underwent some renovation in 2017. Modest, low-cost government policy changes could help homeowners make better building envelopes part of those renovations, when improvements are cheaper and less disruptive by:

- improving homeowner awareness of energy efficiency opportunities before they renovate
- providing access to attractive financing for the incremental costs of deep energy efficiency
- requiring energy efficiency during planned renovations, where it is obviously cost-effective, and
- incenting and training contractors to promote energy efficiency in their projects.

Only by starting now can the majority of Ontario's existing homes become energy efficient by 2050.

3

Contents

3.1 The problem: energy waste in existing buildings

3.1.1 Energy use in all Ontario buildings

In 2017, buildings in Ontario consumed nearly two-fifths (or 946 PJ) of the province's total energy use. Building energy use was 58% natural gas, 35% electricity, and 7% other fossil fuels. These buildings can use much less energy. Large buildings built in 2005 require 50% more energy to operate than those built today, while low-rise homes built in 2005 need twice as much energy as those built today.[1] This energy waste has real economic, environmental, and social costs to Ontarians.

Buildings can use much less energy.

Since Ontario produces less than one percent of Canada's natural gas, yet consumed 28% of Canada's total natural gas production, most of the money spent on natural gas use in buildings is transferred outside of the province, mainly to Alberta, British Columbia, and the United States.[2,3] In 2015, Ontario spent $3.5 billion importing natural gas.[4]

Buildings are also a major contributor to Ontario's greenhouse gas emissions, and were responsible for 34 Mt CO_2e or 21% of Ontario's total greenhouse gas emissions in 2016.

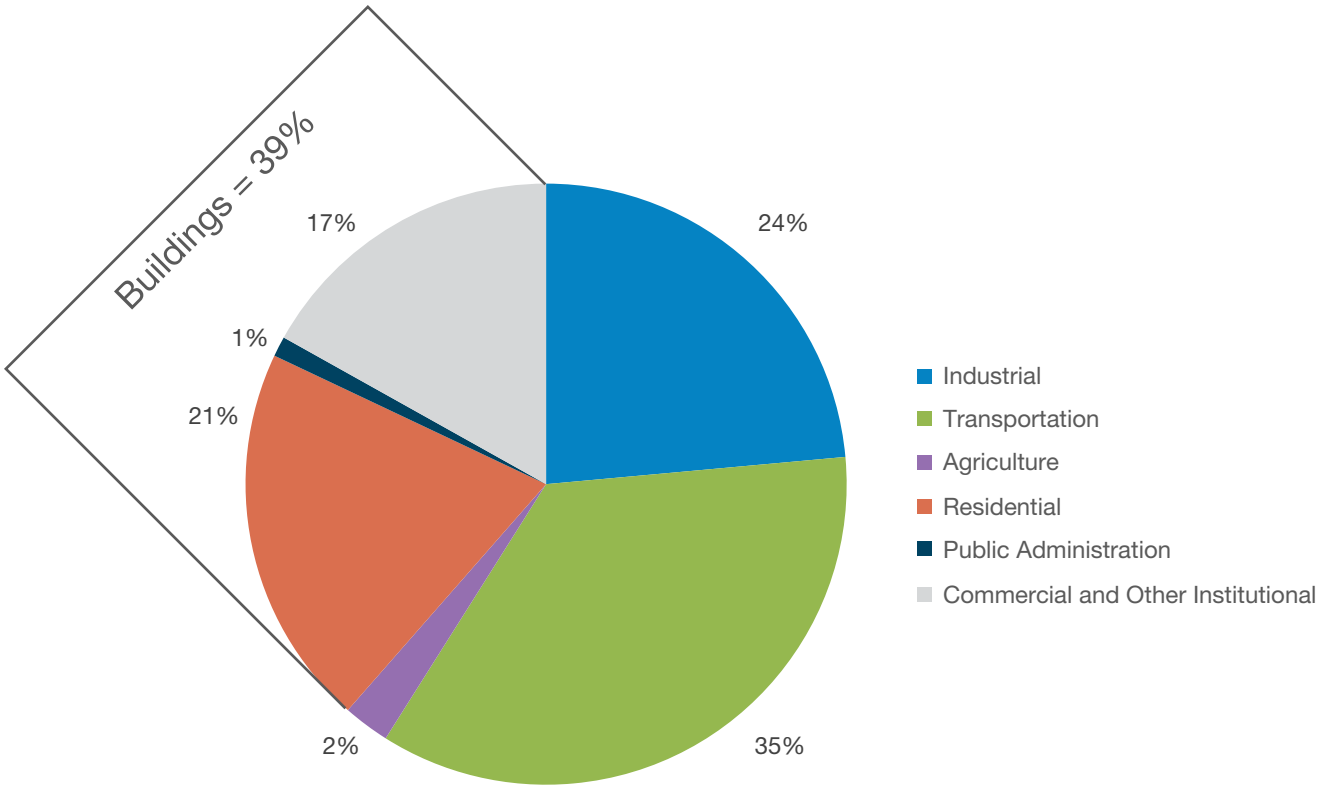


Figure 3.1. Energy use in Ontario by sector in 2017.

Source: Statistics Canada, Table 25-10-0029-01 Supply and demand of primary and secondary energy in terajoules, annual.

3.1.2 Older homes: inefficient and not getting better

Residential buildings account for more than half of all building energy use. In 2015, Ontario's households were the fourth most energy intensive in Canada,[5] and there was no improvement between 2011 and 2015.[6] Because most residential energy use is fossil-fuelled, high energy use also means high greenhouse gas emissions. About 13% (20 Mt CO_2e per year) of Ontario's emissions come from residential energy use, mostly from natural gas fired space and water heating.[7]

There was no improvement in household energy intensity from 2011 to 2015.

The lion's share of residential energy use comes from low-rise residential buildings (referred to here as 'typical homes' or 'homes'), which account for an estimated 83% of all residential energy use. This includes single-detached and single-attached house types as defined by Statistics Canada and Natural Resources Canada. These typical homes are the focus of this chapter because of their significant energy consumption, the limited conservation efforts to date, and the need to start substantially reducing their energy use now.[8]

Ontario needs to increase the energy efficiency of existing homes. The energy wasted by typical homes in Ontario has significant impact on the economy, environment, and prosperity of the province and its residents. Highly energy-efficient homes have lower utility bills, higher resale values, greater indoor comfort and more resilience to extreme weather, but progress to date has been limited. The longer these buildings remain inefficient, the more difficult it will be for Ontario to meet meaningful climate targets. Put simply, household energy waste is unnecessary and burdensome, while deep efficiency can lead to significant benefits.

Energy-efficient homes have lower utility bills, higher resale values, greater indoor comfort and more resilience to extreme weather.

Improvements to the Ontario Building Code have led to dramatic improvements in newly constructed homes in recent years (Figure 3.2). However, while new homes are becoming more efficient, existing homes are being left behind in the energy inefficient past.

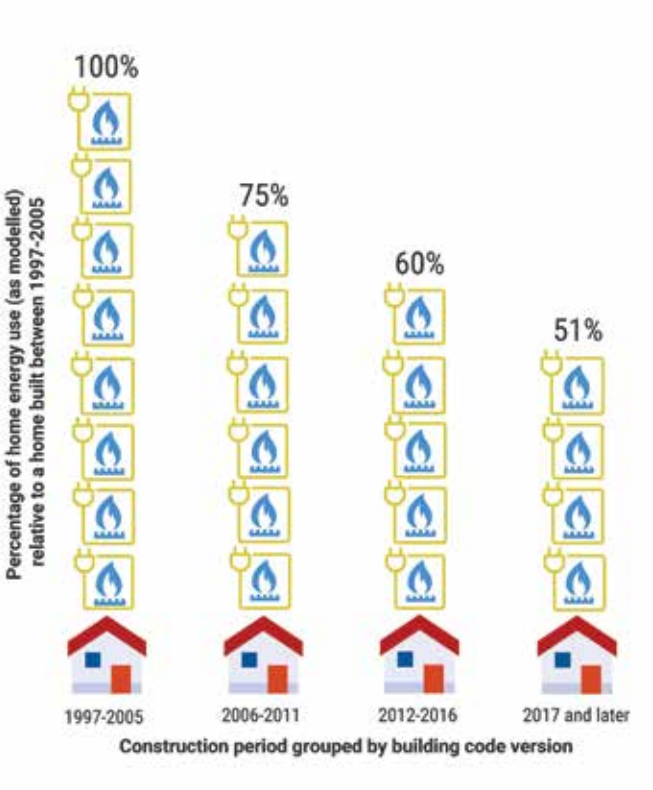


Figure 3.2. Percentage of home energy use (as modelled) relative to a home built between 1997-2005. A house built in 2017 uses roughly half of the energy a similar sized house built from 1997-2005 would.

Source: Ministry of Municipal Affairs and Housing.

Older energy-inefficient homes dominate Ontario's built environment (Figure 3.3). At the end of 2016, 86% of Ontario homes were built before or in 2005. It is impossible to significantly reduce the overall energy use and emissions of Ontario's housing stock without improving the performance of older homes.

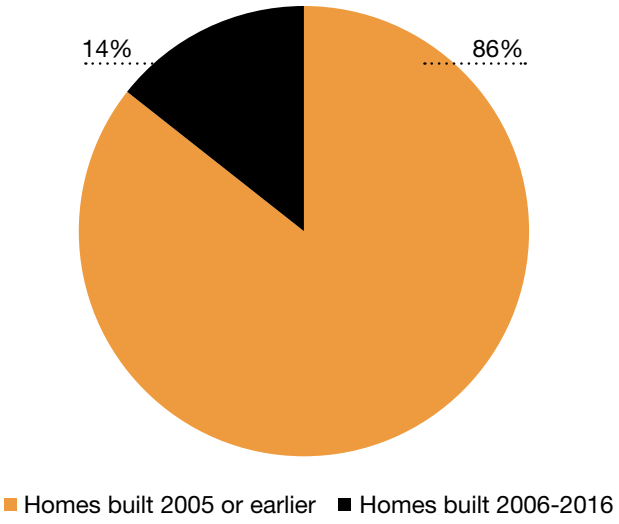


Figure 3.3. Percentage of homes built before or in 2005 compared to homes built after.

Source: Natural Resources Canada, Comprehensive Energy Use Database (2018).

The higher efficiency of new homes and examples of energy efficiency renovations in Ontario and around the globe show that older Ontario homes could be far more efficient and less wasteful. In recent studies assessing Ontario's potential for cost-effective energy savings, existing homes represent half of all potential natural gas savings by 2030.[9] Unfortunately, most Ontario households are allowing energy and money to leak out through their building envelope.

Most Ontario households are allowing energy and money to leak out through their building envelope.

3.1.3 Why we need to start now

The costs of excess energy use to Ontario's households, economy, and environment will persist unless significant action is taken. Meeting climate targets will be significantly more difficult unless energy efficiency in existing homes is prioritized, particularly because three in four buildings that will be in use in 2030 already existed as of 2017.[10] Further, energy-related home components are typically used for decades or more, giving only rare opportunities to reduce energy waste. For example, if a homeowner replaces the siding on their home without upgrading the insulation, that home is likely to remain poorly insulated until 2050 or later. On the other hand, progress and good investments made now will provide benefits well into the future.

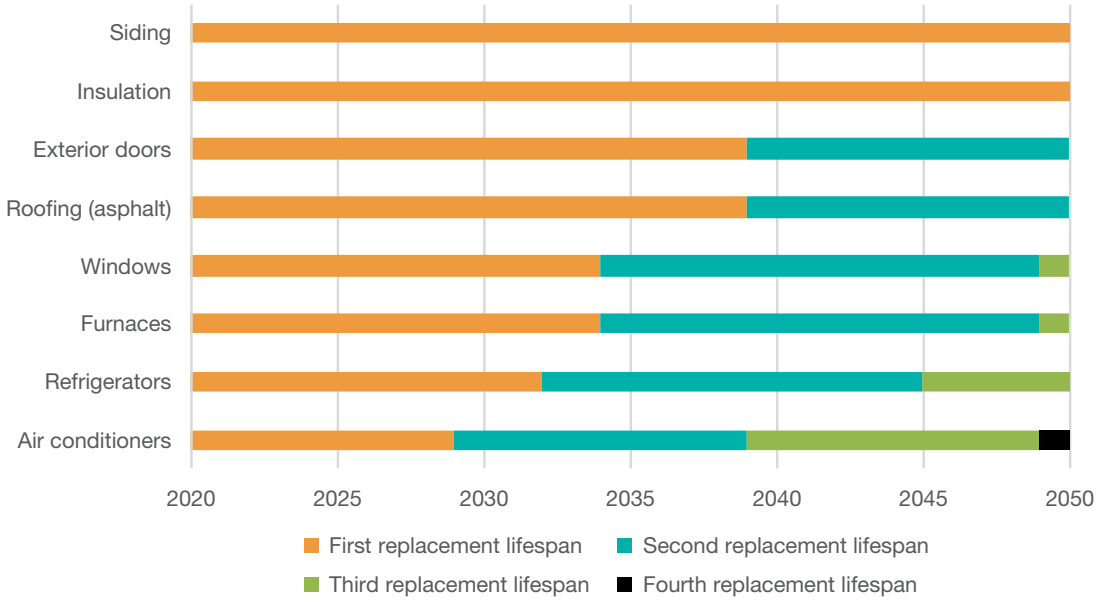


Figure 3.4. Typical lifespan of energy-related home components. There is only one chance to replace insulation and siding before 2050.

Source: National Association of Home Buildings/Bank of America Home Equity, Study of Life Expectancy of Home Components (2007).

One of the most pressing reasons why Ontario needs to start increasing the energy efficiency of homes now is the sheer number of them. There are 3.7 million single-detached and single-attached households in Ontario containing 634 million m^2 of area.[11] For comparison, there are only approximately 0.2 million commercial and institutional buildings in Ontario containing 343 million m^2 of area.[12]

To reach a modest target, Ontario would have to perform deep energy efficiency renovations in 2% of homes every year starting in 2019.

Given the urgency of the climate crisis, Ontario should minimize all fossil fuel waste. The challenge of deeply renovating Ontario homes will only become increasingly difficult if action is delayed. To reach a modest target, say having 60% of homes energy efficient by 2050, Ontario would have to perform deep energy efficiency renovations in 2% of homes every year starting in 2019.[13] That is about 74,000 home renovations per year, equivalent to the number of dwellings of all kinds that were constructed in 2018 in Ontario.[14] It would also mean building up an impressive number of skilled workers to fill demanding and rewarding new jobs.

3.1.4 How to improve the efficiency of homes: tackle the building envelope first

Existing homes would be significantly more energy efficient if they get a well-insulated and airtight building envelope (the walls, roof, floor, doors and windows that separate the conditioned space within a home from the outdoor environment).

Existing homes would be significantly more energy efficient if they get a well-insulated and airtight building envelope.

It is almost impossible to reduce energy use in an existing home to the levels seen in new homes without addressing the building envelope, no matter how efficient the mechanical and electrical equipment is (improving equipment efficiency will result in moderate improvements in overall home energy performance).[15] For the purposes of this report, ECO uses the terms "deep energy efficiency" or "deep energy retrofits" to refer to attempts to reduce overall home energy use by a significant fraction (usually over 30%), which generally require improvements to the building envelope.

Figure 3.5. Thermal imaging of a home shows where heat is being lost. The red colour indicates a higher temperature which means those areas of the house are losing more heat to the outdoors. The yellow and green areas of the house are better insulated and lose less heat.

Photo credit: istockphoto.com/ca/portfolio/ivansmuk.

Upgrading a building's envelope reduces space heating in the winter and cooling in the summer. Space heating accounts for 60% of the energy use in Ontario homes. According to a recent study of Ontario's natural gas conservation opportunities, 72% of all residential natural gas use is for space heating, and four of the five measures with the highest potential natural gas savings and positive economic benefits improved the building envelope (professional air sealing, super high-performance windows, air leakage sealing and insulation in old homes, and draft proofing).[16]

Your home's envelope should be like a warm jacket

A home's envelope is like a winter jacket. Most homes in Ontario have a thin jacket with holes that allows heat to leak out. Upgrading your home's envelope would be like getting a thicker, more insulated jacket with no holes that fits well and cinches tight to keep wind out. You could stand in frigid weather for a long time without getting cold just from your own body heat. Just like how you would not want a flimsy, torn jacket, you would not want an uninsulated, leaky home. If you are going to buy a fashionable jacket, you might as well get one that is warm too.

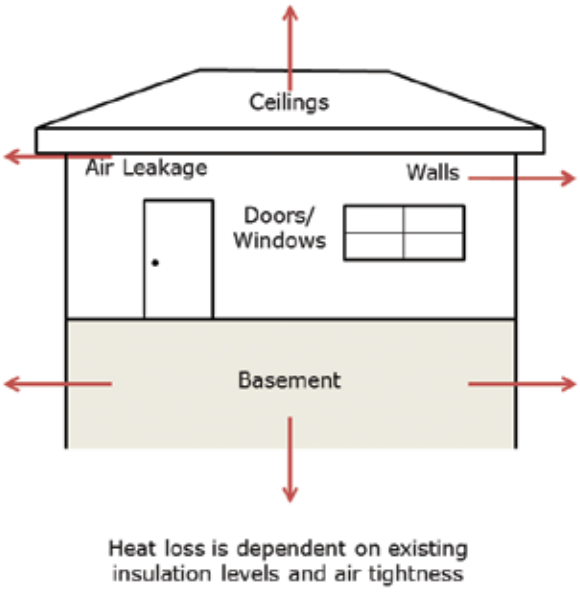


Figure 3.6. Heat leaks can be stopped with insulation and air tightness.

Source: Adapted from Canadian Mortgage and Housing Council, About Your Home (2007).

3.1.5 The benefits of improving the building envelope

Building envelope improvements are the best and often the only way to make a deep cut in home energy use and utility bills to homeowners. They can also deliver co-benefits that cannot be matched by other efficiency measures, such as greenhouse gas reductions, resilience to power outages, and greater comfort.

Energy costs for homeowners

Reducing a home's energy needs through an improved building envelope means lower utility bills and less vulnerability to fluctuating utility rates.

An improved building envelope means lower utility bills.

In 2016, the average expenditure on energy per household in Ontario was $2,391 ($12.4 billion across Ontario), including $718 ($3.7 billion across Ontario) on natural gas.[17] Envelope improvements will reduce this spending. Lowering energy use also makes homeowners less vulnerable to future increases in energy prices. Nominal electricity bills are expected to increase 57% from 2018 to 2035 while natural gas unit costs are expected to increase 25% in real terms from 2018 to 2035, although these estimates will depend to some degree on public policy choices.[18,19] Attempting to reduce energy rates (the cost per unit of energy) does not address the root cause of high household energy costs, which is high consumption. Reducing consumption will be of particular benefit to the estimated 7.5% of Ontarians that experience energy poverty, meaning more than 10% of their expenses are spent on energy.[20]

Further cost savings can occur the next time a furnace or air conditioner needs to be replaced. Because the home would use much less energy after an envelope upgrade, the size and capital cost of the equipment needed to heat and cool the home can go down, often substantially.

Greenhouse gas emissions

In the roughly four in five Ontario homes heated with fossil fuels, conserving energy used for heating obviously reduces greenhouse gas emissions. Reducing energy used for space heating in electrically-heated homes also delivers climate benefits, because natural gas-fired power plants often supply some electricity when space heating is most needed. Improvements to the building envelope that reduce cooling energy use (air conditioning, supplied almost exclusively from electricity) also reduce greenhouse gas emissions by reducing electricity demand when natural gas-fired power plants are running (see **Chapter 2** of this report).

Comfort, resilience and well-being

The well-being of Ontario households can also be improved through building envelope retrofits. Homes with a good building envelope are more comfortable, less drafty, and better insulated from temperature fluctuations. The same inefficient homes that contribute to climate change are also the least likely to be prepared to deal with its consequences, such as extreme weather and power outages. An airtight, well-insulated home is more comfortable and can stay habitable for much longer during power outages (where a source of heating or cooling may be unavailable), improving the resiliency of Ontario's housing stock. These comfort improvements translate to health improvements such as fewer temperature-related stresses, illnesses and deaths.[21]

Homes with a good building envelope are more comfortable.

Frost on the interior side of an inefficient window. Inefficient windows are uncomfortable to be near, lose heat to the exterior, and can result in moisture issues.

Photo credit: Jill Wellington.

Finally, adding insulation not only thermally insulates the building but also makes it quieter. Envelope upgrades also allow homeowners to refresh the look of their home.

Figure 3.7. Multiple benefits from an energy efficient home compared to an energy inefficient home.

Source: Environmental Commissioner of Ontario.

3.1.6 Conservation programs have been missing the building envelope in existing homes

As discussed in **Chapter 2** and **Appendices C** and **D** of this report, conservation programs in Ontario have saved significant amounts of energy. However, much of the focus has been on shallow energy efficiency measures, and energy efficiency in non-residential sectors. For example, from programs delivered in 2016, Enbridge and Union Gas conserved 837,114,041 m^3 and 959,435,289 m^3 of natural gas in lifetime savings, respectively. Of these savings, 69% were in the commercial and institutional sector.[22]

Some past programs supported, though they did not focus on, building envelope improvements. For example, the Canadian government offered rebates for energy efficiency measures through the ecoENERGY program with matching funding from provinces from 2007 to 2012. From January 2008 to November 2010, the three most popular retrofits were furnace/boiler replacement (75%), air leakage reduction (39%) and central air conditioner replacement (33%).[24] Only 15% of participants installed basement insulation; only 11% installed wall insulation.

Today's utility conservation programs for homes largely ignore building envelopes.

Today's utility conservation programs for homes largely focus on basic energy efficiency and ignore building envelopes. For example, residential savings accounted for 46% of Ontario's electricity conservation savings of 1.8 TWh in 2017. However, 81% of these residential savings were from lighting retrofits,[25] (which are unlikely to have significant climate benefits). Ontario's Save on Energy Coupon Program distributed 17 million products in 2016 for improvements in lighting, smart power bars, and pipe insulation.[26]

None of the five current province-wide low-rise residential electricity conservation programs addresses improving the building envelope (except in low income/social housing).[27] Part of the reason may have been that, in Ontario's climate, the bulk of energy (and climate pollution) savings from building envelope improvements comes from reduced use of heating, not cooling. Therefore (except for the minority of electrically heated homes), it makes more sense to target building envelope retrofits in conservation programs designed to conserve natural gas and other heating fuels, but these programs have received only a fraction of the funding historically provided for electricity conservation.

Enbridge and Union Gas do offer modest "whole-home renovation" programs that include upgrades to building envelopes in existing homes.[28] As shown in **Appendix D** of this report, these programs have seen strong growth, but still reach only a small share of customers.[29] Most of this small number of participants used the incentive to improve their heating system, not their building envelope, as discussed below in section 3.1.7. One of the reasons for the small number of participants is that the Enbridge and Union retrofit programs are budget-limited. They compete against other utility conservation programs for a portion of comparatively small conservation budgets set by the Ontario Energy Board. During cap and trade, extra funding temporarily enabled larger programs that were accessible to more people (see the textbox "Cap and trade funding for home retrofits").

Cap and trade funding for home retrofits

A new source of funding for home retrofit programs was temporarily available during Ontario's cap and trade system. $115 million of cap and trade funds were used to expand the Union and Enbridge home retrofit programs,[30] including expanding eligibility to homes heated by fuels other than natural gas, such as propane, heating oil, and wood. The Independent Electricity System Operator also received cap and trade funds which it directed to electrically heated

homes. In addition, $378 million of cap and trade funds were allocated to GreenON, an Ontario agency that also invested in energy efficiency. A fraction of that amount was used for renovations to improve home building envelopes, such as window and insulation retrofit programs.[31] Not all of these funds would have been spent before these programs were cancelled.

Cap and trade funding had enabled retrofits of an additional 25,216 homes.

By November 30, 2018, cap and trade funding had enabled retrofits of an additional 25,216 homes.[32] Of the participants, 84% were homes with natural gas heating, 1% with electric heating, and 15% with other heating sources (propane, oil, wood).[33] Among other things, these retrofits proved the cost-effectiveness of whole-home retrofits for electrically-heated homes. Because of the high cost of electric heating, building envelope improvements save more money in these homes.[34] See the textbox "LDC-Gas conservation collaboration examples" in **Chapter 2** of this report for more discussion on the lessons from the whole-home retrofit program regarding collaboration between different conservation providers.

With the cancellation of cap and trade, the programs it supported were closed to new entrants on November 1, 2018. Thus, the Enbridge and Union Gas ratepayer-funded retrofit programs for natural gas-heated homes are now the sole source of conservation funding for building envelope improvements in existing homes. Participation in home retrofit programs in future years will likely be lower than 2017 and 2018, due to the removal of the cap and trade funding.

3.1.7 What are the barriers to deep home energy retrofits?

Overall, homeowners want energy efficient homes. The vast majority of Canadian homeowners (8 in 10) are interested in buying energy efficient appliances, upgrading their homes' envelope systems, switching to more efficient heating systems and/or buying green energy.

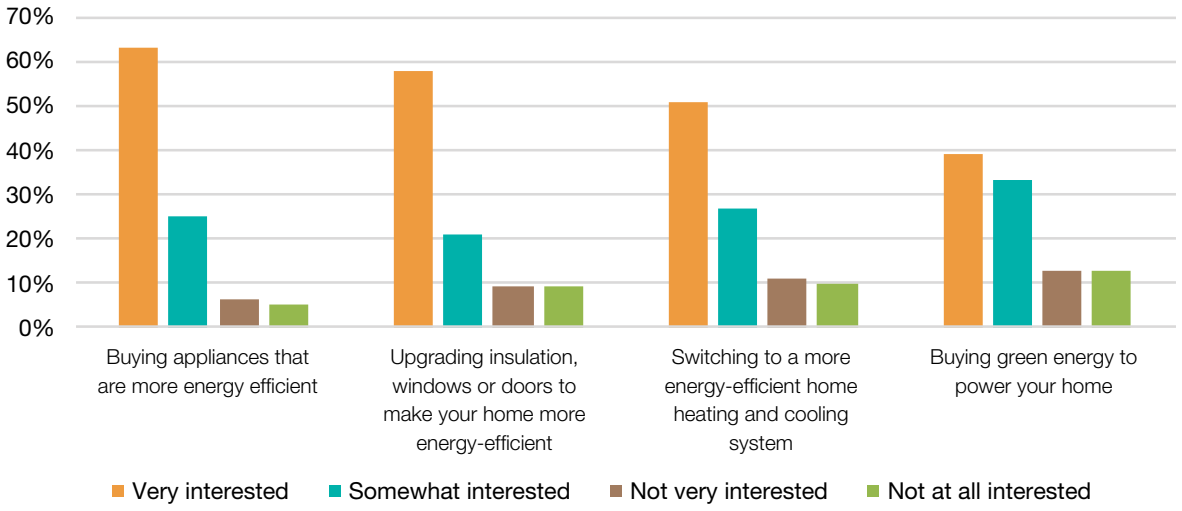


Figure 3.8. Canadian homeowner level of interest in energy efficiency and green energy.

Source: Environics Research, Public Opinion Research on Natural Resource Issues 2017, online: <epe.lac-bac.gc.ca/100/200/301/pwgsc-tpsgc/por-ef/natural_resources/2017/121-16-e/report.pdf> at 30.

However, this interest is not being converted into much action, as illustrated by the Enbridge and Union conservation programs, and their very small share of customers undertaking deep energy renovations. Almost all of the behavioural and market barriers described in **Chapter 1** of this report have an impact in limiting the number of building envelope retrofits in existing homes. Most importantly, homeowners often see deeper energy efficiency renovations, such as envelope improvements and insulation, as unnecessary, inconvenient, and/or too costly.

Homeowners often see deeper energy efficiency renovations as unnecessary, inconvenient, and/or too costly.

Enbridge Gas Distribution's 2016 Draft Annual Demand Side Management (DSM) Report evaluated its Home Energy Conservation program which provided homeowners with rebates of up to $5,000 designed to encourage natural gas saving.[35] In order to qualify for rebates, at least two upgrades or products needed to be installed, and modelled home energy use needed to be reduced by at least 15%. The vast majority of rebates were allocated to homes which had done the minimum necessary, i.e. where only two upgrades or products were installed. Although 44% of participants considered implementing more than two upgrades, 83% of projects had only a furnace upgrade and air sealing.[36] Very few participants selected insulation, although it also qualified for rebates.

Why did participants do so little? About 43% of participants explained that more upgrades would cost too much, and 26% were not convinced their home needed those additional upgrades. As stated earlier, 86% of Ontario's homes were built before 2005 and use at least twice as much energy as a home built in 2017.[37] When asked to rate the barriers to implementing some recommended upgrades, participants rated "Financial challenge such as lack of funds" and "Not convinced of the economic value of upgrades" as their top two.

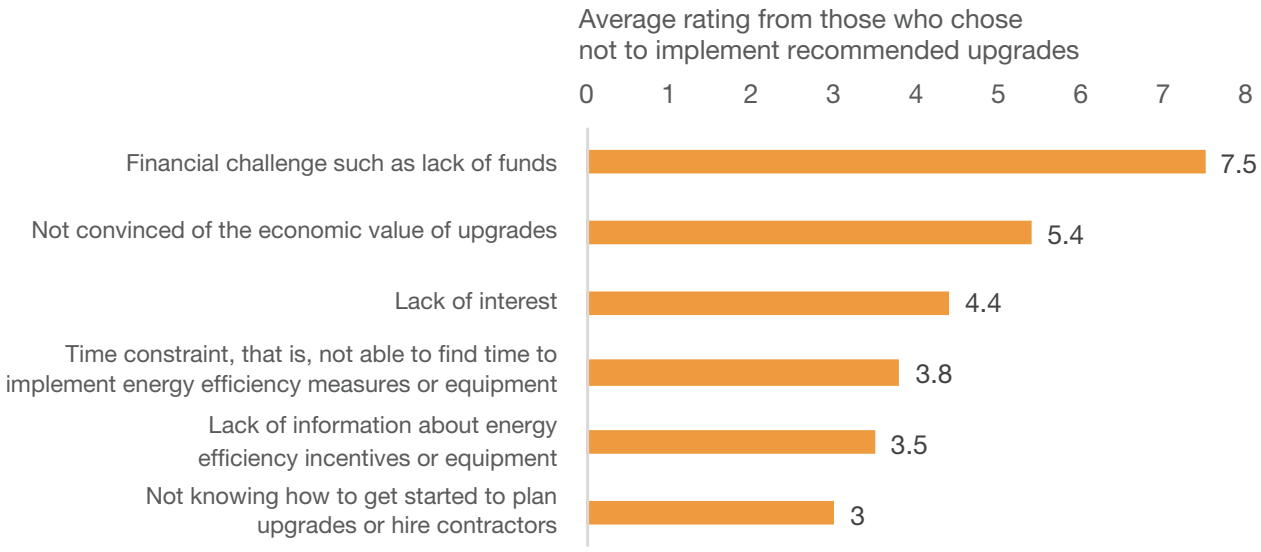


Figure 3.9. Average rating of Enbridge Home Energy Conservation program participants who chose not to implement recommended upgrades.

Survey question: Now, I would like to ask you about the reasons why you chose not to implement those upgrades. I will read you a list of barriers and for each one, please answer on a scale of 1 to 10 where 1 means 'not at all a barrier' and 10 means 'a major barrier'. (n=61). Don't know removed from calculation.

Source: Enbridge Gas Distribution, 2016 Demand Side Management Draft Annual Report at 176.

What worked? Word of mouth and contractors were the two most likely ways to hear about the Home Energy Conservation program. The top three reasons people chose to participate in the program included the following:

- they were already considering/planning work/ upgrades
- to receive incentives/money back, and
- to save money/reduce energy bills.

The most important motivation to participate in the program was to reduce energy bills. Increasing comfort and receiving incentives/money back were second and third, respectively.

Those who did participate in the program saw significant benefits. The vast majority of participants, 87%, felt they knew more about their home's energy efficiency, and 77% reported improved home comfort levels, such as more even temperatures, a warmer home or noise reduction. Further, 77% were satisfied with their overall experience with the Certified Energy Auditor, the professional who evaluated their homes energy use and recommended the energy efficiency measures.

Unlike Enbridge's program, the Union Gas Home Reno Rebate program provided rebate amounts that were prescriptive rather than performance-based (i.e. fixed incentives based on technologies installed, as opposed to basing the incentive on the improvement in whole-home energy performance), and a maximum of $5,000 per home was available (as of February 2018, Enbridge's program has also adopted this approach). Also, a bonus rebate of $250 on top of the typical rebate amount for each measure (the maximum rebate amount remained at $5,000) was available for any additional energy conservation measures beyond two that were implemented. Like Enbridge's program, air sealing and furnace upgrades formed the vast majority of measures implemented (74%). About 15% of improvements were insulation, mostly for attics and basements.[38] Contractors once again played a large role in marketing the program.

Between the Enbridge and Union Gas programs, less than 20,000 homes participated in 2016. At most, around 3,000 of these homes added insulation.[39] This is only 4% of the 74,000 Ontario homes that must make deep energy efficiency renovations each year if 60% of today's existing homes are to be energy-efficient by 2050. The challenge is significant.

Gas conservation programs improve building envelopes for only 4% of the 74,000 Ontario homes that must make deep energy efficiency renovations each year if 60% of today's existing homes are to be energy-efficient by 2050.

3.2 The opportunity: don't waste a renovation

The home renovation market is vast. According to the 2018 CIBC Home Renovation poll, 46% of Ontarians plan to renovate their home "in the next 12 months" and spend an average of $13,600 per renovation.[40] According to Statistics Canada, Ontarians spent $24 billion on renovations in 2017.[41]

Each renovation is a significant opportunity to improve the energy efficiency of existing homes.

Each renovation is a significant opportunity to improve the energy efficiency of existing homes. It is more convenient and less costly to improve energy efficiency when renovation is already underway. However, homeowners are often unaware of the opportunities, feel that they do not offer good value, and/or do not have the funds to undertake them.

A home renovation where insulation was added to the envelope.

Photo credit: Bryn Pinzgaue

To be realistic, most homeowners will not be interested in or able to include deep energy in every renovation. However, because of the large number of home renovations, adding energy efficiency to just a fraction of the renovation market year after year could lead to large improvements in overall residential energy efficiency over time.[42] (Even renovations that do not alter the building envelope are good opportunities to install more efficient equipment such as low-flow water fixtures and ENERGY STAR products. These shallow measures already have reasonable market uptake or conservation programs designed for them.)

Of the 10 most common renovation projects, only 12% affect the building envelope.

The minority of home renovations that alter the building envelope are especially important. Of the 10 most common renovation projects in Canada, only 12% affect the building envelope.[43] This makes it a serious missed opportunity whenever an envelope renovation fails to add additional insulation and air tightness.

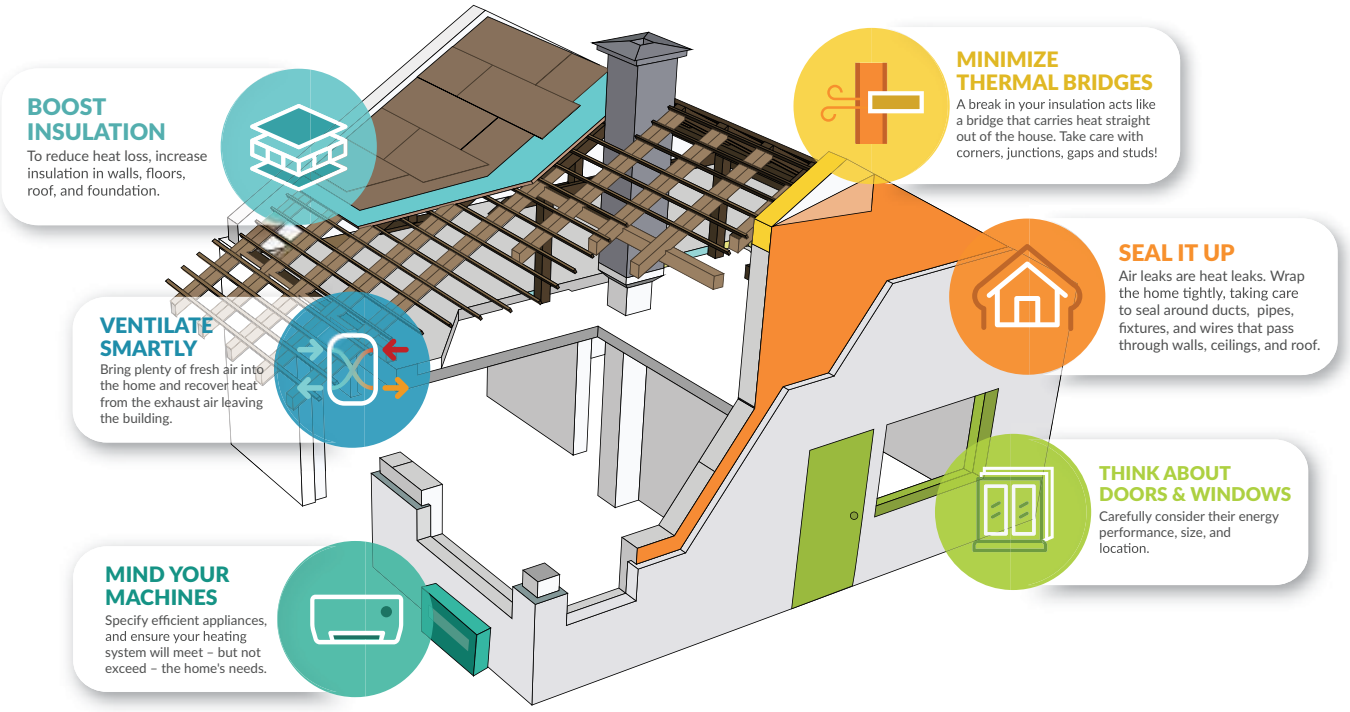


Figure 3.10. Recommendations for energy efficiency in homes primarily focused on improving the building envelope.

Source: Energy Step Code Council, Energy Step Code.

Upgrading a building's envelope during planned renovations is less costly and disruptive than it would otherwise be because much of the upfront work that would be needed to install energy efficiency measures (e.g. accessing wall cavities or roofs in order to add insulation) is already being done. Natural Resources Canada's Local Energy Efficiency Partnerships (LEEP) challenged the industry to propose exterior insulation renovations for a typical home in London, Ontario,[44] and one manufacturer estimated the pre-work to remove the brick and siding alone constituted 14% of the renovation cost.[45]

Even if done as part of planned renovations, building envelope upgrades, particularly deeper retrofits that cover a large percentage of the envelope, are expensive. Financing options detailed later in the report would allow the upfront cost to be spread over a long time and/or transferred in the event of a change in ownership.

Scaling up energy efficiency renovations: Now House 95

The Now House project started in 2007 and performed numerous deep energy retrofits on low-rise homes in Ontario. The first home in Toronto cost $85,000 (including solar PV) to renovate, reduce natural gas use by 79%, reduce electricity use by 25% and improve the home's EnerGuide rating from 68 to 94.[46] Under the feed-in tariff, the solar production allowed this home to achieve zero-energy cost on an annual basis.

The project then renovated five homes in Windsor with air sealing, compact fluorescent lighting, low-flow water fixtures, ENERGY STAR appliances, new doors, new siding and a variety of other measures. The average cost was approximately $42,000 (not including solar PV) with the base package of insulation costing just over $18,000 (43% of the total cost). The retrofits on average reduced natural gas use by 53% and electricity use by 26%, and saved $760/year on utility bills.[47]

Based on these results, 95 additional homes were retrofitted by the community housing corporation in Windsor with a standard set of measures (exterior wall insulation, basement wall insulation, furnace replacement, window and door replacement) achieving an average 48% improvement in their EnerGuide ratings at a cost of approximately $25,000 per home before rebates.[48]

The Now House project demonstrates that deep energy efficiency is achievable in existing homes, that envelope renovations can be integrated with other renovations at reasonable costs, and that, with scale and experience, the cost of deep energy efficiency becomes increasingly feasible.

With scale and experience, the cost of deep energy efficiency becomes increasingly feasible.

3.3 Achieving deep energy retrofits

Ratepayer-funded utility conservation programs will continue to be important in encouraging energy retrofits (discussed earlier in section 3.1.6). Significant gaps in program availability that could be addressed include the lack of whole-home retrofit programs for homes heated by sources other than natural gas, such as electricity, heating oil, and propane. Because of the high cost of heating with these fuels, building envelope improvements save more money in these homes. Program results from the period when cap and trade funding was available show that a program would be cost-effective.[49] The future of utility programs is discussed in **Chapter 2** of this report.

Low-cost policies can drive deep energy efficiency during planned renovations.

Other important, low-cost policies to drive deep energy efficiency during planned renovations are to:

- improve homeowner awareness of energy efficiency opportunities before they renovate
- provide access to attractive financing for the incremental costs of deep energy efficiency
- require energy efficiency during planned renovations, when obviously cost-effective, and
- incent and train contractors to promote energy efficiency in their projects.

The objective of this suite of interventions is to transform the home renovation pathway so that the majority of Ontario's existing homes see significant energy reductions by 2050.

Tax credits for energy efficiency need careful design

The provincial government's draft Environment Plan made a commitment to "consult on tax policy options to make it easier for homeowners to increase energy efficiency and save money." The ECO has been informed that this is a reference to possible tax credits for energy efficiency upgrades.[50] As with utility conservation programs, tax credits can provide a direct financial incentive for home retrofits.

The US has had a form of this policy in place since 2005, which can provide insights into its effectiveness. The US provides two separate tax credits, one for energy efficiency improvements to homes and another for renewable energy improvements to homes.[51] Analysis of these policies by the Congressional Research Service generally points towards the tax credits not being effective at overcoming the market barriers (mainly high upfront cost) to energy efficiency.[52] This is primarily due to the delay between paying the cost and receiving the credit, which diminishes the credit's value. Most of the tax credit claims come from those that also report high incomes, which enforces the theory that the policy is not necessarily addressing the high upfront cost barrier. Any tax credit incentive in Ontario should reduce the time between homeowners incurring the cost and receiving the rebate, restrict eligibility to measures that deliver proven energy savings and perhaps limit the credit for high-income individuals or high-value homes.

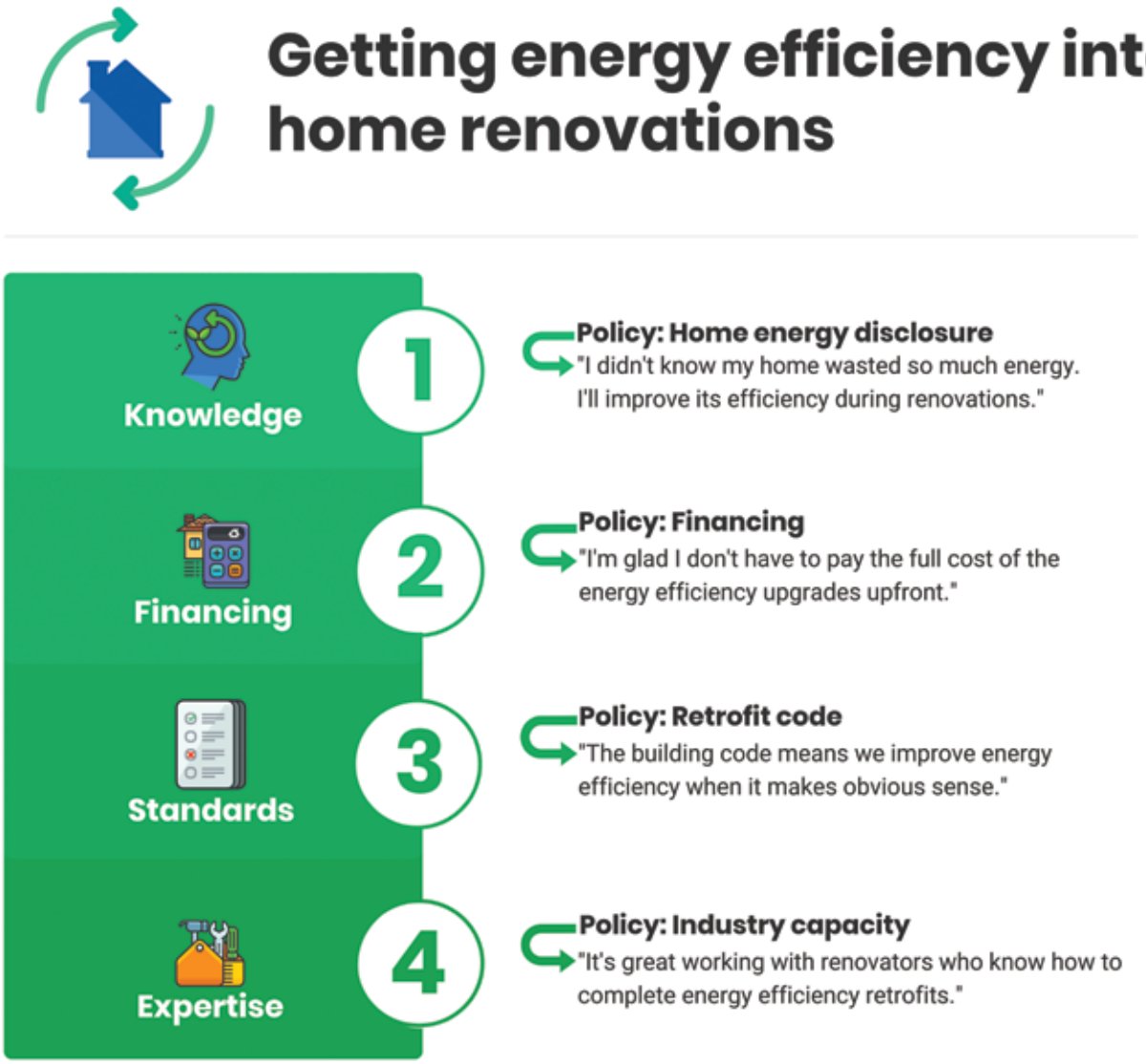


Figure 3.11. How each policy aims to transform the renovation pathway to include more energy efficiency.

The four policies listed above (along with conservation programs) address critical points along the pathway homeowners and contractors take when considering renovations and energy efficiency and attempt to overcome the barriers to conservation that were discussed earlier in this chapter and in **Chapter 1** of this report.

Table 3.1. Policy solutions to overcome barriers to home energy retrofits.

Barriers to home energy retrofits	Policy solutions
Behavioural barriers	
Lack of reliable information	Home energy disclosure, industry capacity, retrofit code
Perceived risk and uncertainty	Industry capacity, retrofit code
Upfront costs	Financing, conservation program incentives
Market barriers	
Split incentives	Financing (if financing can be transferred upon change in home ownership)
Lack of fair pricing for efficiency compared to energy supply	Conservation program incentives
High borrowing and transaction costs	Financing

All four of these actions are needed to ensure that the maximum number of homeowners include energy efficiency in their envelope renovations. Piecemeal implementation will result in homeowners missing significant opportunities to improve the energy efficiency of their homes.

3.3.1 Getting energy efficiency into the renovation plan: home energy ratings

In order to get energy efficiency into renovation plans, the cost of energy use in homes and ways to reduce it needs to be communicated to homeowners at a time when they are likely to undertake renovations.

People often consider renovating when they are about to buy or sell a home.[53] One key way of incorporating energy efficiency into the plan is for home sellers to disclose the energy rating of their home and include it on the home listing. This is also known as Home Energy Rating and Disclosure. By requiring disclosure, homebuyers can factor the energy usage of a home into their purchase decision. Homebuyers and sellers would also be incentivized to improve a home's energy rating before sale or after purchase when renovations are often more convenient. Knowing a home's energy usage enables buyers to make informed choices, much like knowing a car's fuel economy.

Knowing a home's energy usage enables buyers to make informed choices.

Figure 3.12. A home energy rating allows people to see how energy efficient a home is before they make decisions on whether to buy or not. Just like how getting an A would be great on a report card, having an excellent home energy rating would be attractive for a home.

Source: Environmental Commissioner of Ontario.

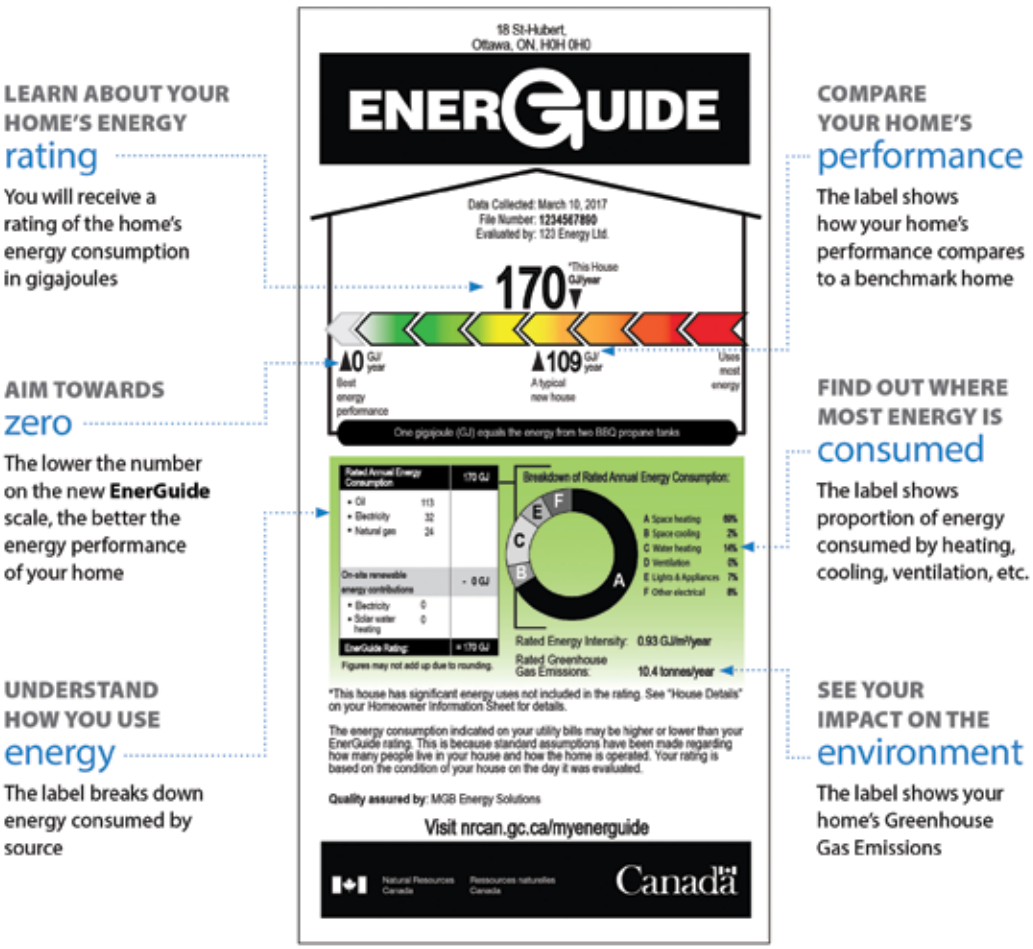


Figure 3.13. Example of a home energy rating label from EnerGuide.

Source: Natural Resources Canada, EnerGuide Rating (2019), online: <www.nrcan.gc.ca/energy/efficiency/homes/20572>.

To be valuable, a home energy rating needs to do several things: be highly visible to prospective buyers in order to potentially influence their purchasing decision or post-purchase activities; describe the current energy performance of a house (ideally in comparison with other houses); outline the impacts (financial and non-financial) of the home's energy use; and identify the steps that could be taken to improve energy efficiency and the costs and benefits of doing so.

A detailed home energy rating can save much money over time. The best practice is for a rating to be based on a home energy audit conducted by a trained energy advisor who uses the EnerGuide rating system and recommends renovations. The upfront cost, typically

A detailed home energy rating can save much money over time.

$350 to $400, is often reimbursed by conservation program incentives if the recommendations are followed.

Utility costs are a significant concern for Ontarians and disclosure would enable sellers of energy efficient homes to market low energy costs as a selling feature. Other personal benefits of energy efficiency may be equally important to some homebuyers (see the textbox "What motivates homeowners to invest in energy efficiency?").

What motivates homeowners to invest in energy efficiency?

Home energy ratings and other energy informational tools typically focus on disclosure of energy costs (and possible energy cost savings from efficiency improvements) as the driver to motivate homeowner investment in energy efficiency. However, non-energy benefits may be equally important, or more so, for some homeowners.

It would be helpful to show homeowners how insulation and air sealing improve the comfort and safety (resiliency) of their homes, and reduce their personal contribution to climate change. Further, envelope renovations can revitalize the look of a home. Comfort, safety and aesthetics are highly valued traits that speak more to the emotional reasons for an envelope renovation. Connecting deep energy renovations with these highly valued traits may cause homeowners to desire such renovations in the first place. Government, individuals and the private sector can all do their part to promote and consider these non-energy benefits of deep energy renovations.

A more complete list of the elements that could be addressed by a comprehensive disclosure policy include:[54]

- ensuring good quality, consistent, trustworthy and available energy auditors to provide ratings and reports
- clear communication of the level of energy efficiency and the opportunities for improvement in reports to homeowner
- making educational resources about the disclosure program available to homeowners, realtors, and energy auditors
- high visibility of reports and ratings from energy auditors during home listing
- fair application to all homes regardless of the means of sale
- addressing privacy concerns of home sellers and buyers
- defining the time between a previous energy rating or energy efficiency improvement and requirement for a new energy rating
- gradual roll out to ensure adequate homeowner buy-in, industry capacity and education
- eventual compliance regardless of home sale or not (e.g., homeowners must obtain an energy audit and rating within 10 years of law passing or the home being built)
- fairness and effectiveness of compliance and enforcement mechanisms, and
- decisions on whether disclosure requirements should apply to rental properties and if it should be triggered when property listed for rent.

Canadians want home energy ratings.

In general, Canadians want home energy ratings. Over nine in ten Canadian homeowners said that a home's energy rating was something they would want to see when shopping for a home.[55] Further, 76% said they were in favour of the government requiring home sellers to obtain an energy rating and 67% said they were in favour of the government requiring home sellers to share the home's energy rating with the public.[56]

A number of other jurisdictions in Europe, the United States and Australia already have some version of home energy disclosure. Ontario can learn from these jurisdictions on how to optimize the design and implementation of its own disclosure policy. Home energy disclosure programs in other jurisdictions have shown positive correlations between home valuation

and home energy rating, in the range of 2-6% increase per increment of improved rating (i.e. from four stars to five stars or from a C grade to a B grade).[57] Disclosure programs have also led to 12-37% of homeowners undertaking or performing more energy efficiency upgrades than otherwise planned.[58]

Home Energy Ratings in Ontario

Ontario had legislation enabling home energy disclosure as part of the Green Energy Act, but this section of the Act was never proclaimed. There were several rounds of consultation, but no decisive action was ever taken. As recently as fall 2017, the 2017 Long-Term Energy Plan noted that "the Province is examining options to deliver a Home Energy Rating and Disclosure program that would improve customer awareness by allowing homebuyers to compare homes by energy rating and encourage uptake of retrofit incentive programs."[59]

On December 6, 2018, the Green Energy Repeal Act came into force. While this law preserved most conservation-related provisions of the previous Green Energy Act (by re-enacting the provisions under other statutes), the home energy disclosure provision was eliminated. The Ministry of Energy, Northern Development and Mines provided no reasons for not carrying forward the legislation, except that this section had never been proclaimed.[60]

Ontario's 2018 draft Environment Plan, which was released on November 29, 2018, proposes to work with the Ontario Real Estate Association to encourage the voluntary display of home energy efficiency information on real estate listings. Enbridge previously delivered a voluntary program ("Know Your Energy Score") but this program was generally ineffective in getting realtors to provide energy ratings at time of listing and has since been cancelled. In 2015, 10 brokerages collectively responsible for 41,650 home listings participated in the program but only 333 home ratings were marketed. Stakeholders felt home ratings could delay or complicate expediting home sales; were difficult to understand or confusing; and did not reflect actual operating costs.[61]

In its work with the Ontario Real Estate Association, Ontario should develop and track outcome metrics (e.g., percent of home listings with energy ratings) to assess whether this voluntary approach is achieving results. If it is not, the ECO believes some form of home energy disclosure should be re-enabled, made mandatory, and put into force.

A less ambitious, less expensive alternative

Inevitably, there are trade-offs between the cost of obtaining a home energy rating, and its completeness and ease of use. If the upfront cost of a home energy audit (typically $350 to $400) is considered unacceptable, notwithstanding the large savings that can follow, partial energy disclosure is possible at almost no cost.

Partial energy disclosure is possible at almost no cost.

For example, several jurisdictions in the U.S. require at least 12 months of utility bills to be disclosed prior to the sale of a property. New York State and Chicago, Illinois have had the policy in place since 1987.[62] Utility bills are a readily available source of data that helps homebuyers factor in the energy use of a home and require minimal resources to disclose. In Chicago, homes that disclosed their utility bills sold quicker and for 1.3% more than homes that did not disclose their utility bill.[63] Utility bill disclosure is a less accurate predictor of future energy performance than a home energy rating, as it is affected by previous occupancy (e.g., was the house vacant for periods?) and occupant behaviour, and does not provide information on how to improve energy performance. But it is much better than nothing, and the public can understand utility bills without additional explanation. If this approach is used, utility bills should be disclosed at time of listing (and as an obvious part of the listing) so homeowners can factor energy cost into their purchase decisions.

Some Ontario energy utilities have experimented with providing additional information on bills that compares a home's energy use with peers (e.g., homes in the same neighbourhood, or homes of similar age and size).[64,65] This is known as social benchmarking. Social benchmarking can improve homeowner awareness of energy use and thus greater likelihood of getting energy efficiency in renovation plans. The homes that stand out in these comparisons as the worst energy performers usually have the most to gain from energy retrofits.

The worst energy performers usually have the most to gain from energy retrofits.

The ECO recommends that the Ministry of Energy, Northern Development and Mines promote energy transparency in existing homes by requiring mandatory disclosure of selected home energy information at time of listing.

Home energy disclosure alone will not transform Ontario's housing market, but it is a critical piece of the recommended policy plan in this chapter. Disclosure addresses a fundamental barrier to energy efficiency: homeowner awareness and prioritization.

3.3.2 Access to financing

When deep energy efficiency improvements are made during planned renovations, costs are already cut significantly. However, as seen through Enbridge and Union Gas' whole-home energy retrofit programs, the upfront costs of deep energy retrofits are still challenging for many. Also, homeowners may be reluctant to invest in energy efficiency if they may sell the home before fully realizing the cost savings from their investment.

Attractive and flexible financing will spur more deep energy efficiency improvements to take place because it enhances the affordability and accessibility of undertaking these improvements while allowing the costs to be transferred in the event of a change in ownership. While grants/rebates are attractive to households since they are direct discounts, offering both grants/rebates and financing can spur more energy efficiency than each type of program alone.[66]

Financing helps overcome the barrier of high upfront costs (and delayed savings) for conservation projects. Because energy efficiency delivers a value stream in the form of utility bill savings, its impact on the credit profile of borrowers is different than many other types of consumer spending. This feature can be taken advantage of by designing energy efficiency financing programs that offer lower rates of interest or can be extended to borrowers who might not typically qualify for credit. Financing is a very cost-effective method for the Ontario government to incent deep energy retrofits, which then help achieve resiliency, emissions reductions and energy efficiency.

Energy savings can often offset the costs of financing, especially at modest interest rates. Table 3.2 from Lawrence Berkeley National Laboratory shows the annual energy savings required to offset the cost of borrowing for upgrades.[67] While some homeowners may not break even on bill savings alone, they can receive additional value when factoring in the improved comfort, higher resale value, and reduced capital equipment costs that come along with deep energy retrofits.

Financing is a very cost-effective method for the government to incent deep energy retrofits.

Table 3.2. Energy upgrade costs, interest rates and annual savings required to break even in USD. A 30-year loan term, no down payment, and a 25% mortgage interest deduction are assumed.

Interest Rate	Energy Upgrade Costs (USD)					
	$5,000	$10,000	$15,000	$20,000	$50,000	$100,000
	Required Annual Savings for Neutral Net-Costs					
3.0%	$204	$408	$612	$817	$2,041	$4,083
3.5%	$221	$442	$663	$884	$2,211	$4,421
4.0%	$239	$477	$716	$954	$2,386	$4,771
4.5%	$257	$513	$770	$1,026	$2,566	$5,132
5.0%	$275	$550	$826	$1,101	$2,752	$5,503

Source: Brennan Less and Iain Walker, Deep Energy Retrofit Guidance from Building America Solutions Center (2015) at 14.

Energy-specific financing helps bring deep energy efficiency to more homeowners.

Energy-specific financing helps bring deep energy efficiency to more homeowners in several ways: by offering competitive (and often below-market) interest rates; providing a financing option for customers with poor credit history; and by overcoming the informational barriers to customers finding an alternate source of credit.

On-bill financing

Financing could be provided through on-bill financing (OBF), a system that is already enabled in Ontario but is not yet offered by any electric local distribution company (LDC) or gas utility.[68]

OBF typically involves utility companies paying the upfront costs of an improvement and charging customers the financing costs through their utility bills until fully recouped. Although permitted, OBF is not offered by LDCs possibly because there is no incentive for them to do so. Enbridge and Union have stated that either customers do not need OBF or that OBF would change the risk profile to their investors.[69] However, OBF could increase participation in utility-run conservation programs, and Ontario could potentially promote the use of OBF by utilities by enabling energy savings from OBF-funded projects that are not part of existing utility programs to count towards Demand-Side Management (DSM) and Conservation and Demand Management (CDM) targets.[70] The OEB reviewed on-bill financing for natural gas utilities as part of its Mid-Term Review. In its decision, the OEB did not recommend that the utilities provide financing, but directed them to allow other service providers to use the utility bill for conservation-related services, including financing.[71]

Manitoba Hydro's successful on-bill financing program

Manitoba Hydro's OBF program (the Home Energy Efficiency Loan, formerly Power Smart) has been very successful, having delivered $400 million in financing since its inception in 2001.[72] Over 17% of Manitoba households have participated in the program. The most popular type of project are window retrofits, representing 47% of the measures implemented. Furnace replacements are the second highest measure at 33%. The average annual savings per project is 825 kWh.

The program has seen success due to its attractive rates, the trustworthiness of the utility, and the speed of processing applications.[73] Homeowners often asked their contractors about the program, creating sufficient demand for contractors to pursue program training and to process the applications required for each homeowner.[74] Contractors also saw value in the program because successful applications guaranteed payment to them.[75] The program saw the greatest adoption when the ecoENERGY program was also running, further indicating that combined financing and rebates leads to greater adoption.[76] Ontario should apply those lessons and program characteristics when rolling out financing programs locally.

Note: Manitoba has one utility for all electricity and natural gas supply. In Ontario's disaggregated system, consistency and marketing are more challenging.

Local Improvement Charges

Local Improvement Charges (LIC) are another form of financing that spreads the capital costs of improvements over multiple payments on the property tax bill. LICs are already in use by municipalities for infrastructure and expanded to include energy conservation in 2013. An LIC-based energy efficiency financing program is currently offered in Toronto and being developed in Guelph (see the textbox "Municipal energy efficiency financing in Toronto and Guelph"). As property taxes are under municipal jurisdiction, LIC financing can be encouraged by providing funding to municipalities to establish LIC programs and share best practices. Coordination of LIC programs (between municipalities or on a provincial level) could also help pool program administration costs and knowledge as well as streamline the process for building owners that cross municipal jurisdictions.

Both OBF and LIC financing can use bill payments (either property tax or utility) as a proxy for creditworthiness. Both have had historically low default rates. One reason for supporting both types of financing is to capture a broader market since those who do not qualify for LIC financing due to their mortgage lender approval may qualify for OBF.

OBF can either be attached to the person who initiates the energy efficiency improvement (i.e. the initiator keeps paying even if they sell the property) or attached to the property (i.e. if ownership changes, the new owner and thus beneficiary of the renovation pays for the financing). LIC financing in Ontario is attached to the property and is transferred to new owners or can be paid off in advance of sale. The property-attached financing is made transparent to potential homebuyers.

Attaching the financing to the property, not to the person, has advantages and disadvantages. It typically eases the concerns of homeowners who may not plan to live in a home long enough to recoup the full benefits. However, it can create new concerns for mortgage lenders, as property taxes take priority over mortgage payments in the event of delinquency. LIC programs in Canada and the US have therefore

typically seen challenges with obtaining mortgage lender approval. About half of the approved applicants in Toronto's single-family Home Energy Loan program were not able to obtain mortgage lender approval for the financing.[77]

3

A GHG emissions reduction fund could provide a loan-loss reserve to leverage financing for energy efficiency.

This obstacle can easily be overcome through a provincial loan-loss guarantee for mortgage lenders. Ontario's draft Environment Plan mentions a GHG emissions reduction fund (named as the Ontario Carbon Trust, although this name could change).[78] This fund could provide a loan-loss reserve to leverage financing for energy efficiency.[79] This could work well to provide as a loan-loss guarantee for municipal LIC programs or to increase the attractiveness of LIC financing for measures that deliver real reductions in fossil fuel use. This would enable more homeowners to successfully participate in LIC programs, making it more likely that other Ontario municipalities would be interested in launching such a program. As LIC programs have traditionally seen very low delinquency rates, the cost to the province would be small. In fact, US properties participating in an LIC program have lower delinquency levels on property tax than the overall average of all properties.[80] As programs expand, the private sector has a vested interest to begin capitalizing on the demand. Consideration should be given to transitioning to private sector financing once energy efficiency renovations have a proven record.

Municipal energy efficiency financing in Toronto and Guelph

Toronto's Home Energy Loan Program (HELP) and High-Rise Retrofit Improvement Support Program (Hi-RIS) are two LIC programs targeted at single family and multi-unit residential properties, respectively. The programs have resulted in significant decreases for participants in energy use (20-30%), utility bills ($560/year for single family and $34,000/year for multifamily residences), and a 20-30% GHG emissions reduction per year for single family and multifamily residences.[81] While only 210 single-family residences and 15 multi-unit residences have been approved so far, momentum is building. Banks are also collaborating with the City of Toronto on expediting the approval process. HELP requires banks to approve of the financing due to a lien on the property that takes priority over the banks' lien. Both HELP and HI-RIS incorporate pre- and post-retrofit energy audits to verify retrofits are completed as proposed and impacts are measured.

Guelph has been exploring LIC financing as part of its Guelph Energy Efficiency Retrofits Strategy, although it has yet to launch a program. Additional details on Guelph's energy efficiency retrofit program are expected in 2019. Guelph's most recent Community Energy Initiative prioritizes retrofitting homes built before 1980 as its number one action to achieve net zero carbon by 2050.

The ECO recommends that the Ministry of Energy, Northern Developments and Mines and the Ministry of the Environment, Conservation and Parks support and increase the use of third-party financing options for energy efficiency renovations, such as municipal Local Improvement Charge programs, utility on-bill financing, and the use of the Ontario Carbon Trust.

Providing financing for deep energy renovations is critical, given their high upfront cost. Without attractive financing, homeowners and contractors are much less likely to perform deep energy retrofits.

3.3.3 A retrofit code

Regardless of attractive financial incentives and adequate industry capacity, some homeowners will not undertake energy efficiency measures during their renovations. Deep energy efficiency measures in such homes can be significantly increased through a retrofit code. Renovations that significantly alter a building must already be brought up to code in terms of fire safety and structural safety, because their cost is justified by their public and private benefits. Because of the significant public and private financial, climate and well-being benefits of energy efficiency, obviously cost-effective energy performance improvements should also be mandatory during major renovations, and would be less expensive if routine.[82]

Energy performance improvements should be mandatory during major renovations.

A well-designed retrofit code can result in significant gains for homeowners who are not aware or not convinced of the cost-effective energy efficiency improvements possible. Retrofit codes make the most of the lower incremental costs of planned renovations or the higher potential energy savings in less energy efficient buildings. Key design options are listed in Table 3.3.

Table 3.3. Triggers and policy traits for different retrofit code options.

Trigger for Code	Policy traits and trade-offs
Building Permit Application	- usually triggered by specific types of renovation actions that enable energy efficiency opportunities (e.g., opening up exterior walls) - well-timed with planned renovations, especially larger scale ones that require building permits - does not strategically target only buildings that are performing poorly - building permitting stages may be too late to incorporate certain changes in design, so effective education campaigns are necessary - building officials will require training and resources for enforcement - risk of driving some renovations under the table (i.e. outside permitting process) to avoid cost of energy upgrades
Energy Performance (poor performers required to retrofit)	- would need to utilize home energy disclosure or some other method to identify poor performers - more likely to have better return on investment since energy savings are greater - may not be timed with planned renovations - social motivation when homes receive poor ratings may be powerful driver for improvements even if retrofits are not required

Source: Environmental Commissioner of Ontario.

It is important to design the retrofit code to minimize shifts to illicit building renovation projects that increase the risk to homeowners and renovation professionals. As discussed below in section 3.3.4, home renovation projects with proper permitting and quality work can be incentivized by restricting eligibility for financing and grants to properly permitted and certified work. Ontario should work with the renovation industry to identify other issues and maximize compliance and effectiveness.

Currently, homes that undergo significant renovations are not required to improve the building envelope. A retrofit code could require sensible upgrades to be made when the benefits would typically outweigh the costs helping to modernize Ontario homes. For example, the addition of insulation and air sealing when walls are already being exposed is low cost but greatly improves home comfort and energy efficiency.

Photo credit: agit-prop.

Building officials may not currently be familiar with some types of innovative high efficiency envelope retrofits, so to successfully implement a retrofit code, building officials will need training to recognize and quickly approve and inspect these retrofits. Any hindrance to obtaining building permits for more energy efficient envelopes could become a pain point for industry and homeowners. The province could also give priority to approving energy efficient envelope building permits.

Renovation requirements in other North American jurisdictions

Vancouver already puts modest energy requirements on existing buildings when they undergo renovation.[83] Projects over $5,000 require an EnerGuide Home Evaluation; larger projects also require simple building envelope improvements. Vancouver is looking to revise the retrofit code to be more flexible in different renovation scenarios.

Table 3.4. Vancouver Building by-law 11 for single-family home renovations.

Total project cost	EnerGuide Home Evaluation and upgrades required
Less than $5,000	Not required
$5000 to $24,999	EnerGuide Home Evaluation
$25,000 to $49,999	EnerGuide Home Evaluation + air sealing
More than $50,000	EnerGuide Home Evaluation + air sealing + improve attic insulation

Source: City of Vancouver, Energy Requirements for Single Family Home Renovations.

A jurisdictional scan done for the Ministry of Municipal Affairs and Housing found that energy standards in the building code used in all U.S. states (versions of the International Energy Conservation Code) do technically apply to renovations in existing buildings (with certain exceptions). It is not stated whether all states enforce these provisions. California is the only state referenced in the scan that has made amendments to its building code specifically addressing existing buildings.[84]

Ontario progress towards a retrofit code

Under the current Ontario Building Code, any "material alterations or repair to existing building systems" to these buildings must only maintain the same performance level of the building before the material alteration or repair.[85]

The Ontario Ministry of Municipal Affairs and Housing has done significant work on energy efficiency requirements in the Building Code for renovations.

The Ontario Ministry of Municipal Affairs and Housing (MMAH) has done significant work on energy efficiency requirements in the Building Code for renovations of existing buildings. In 2017, the MMAH consulted on potential energy efficiency requirements for renovations to existing homes more than five years old, which would be triggered by certain types of renovations.

Generally speaking, the proposals would require building systems undergoing material alterations or repairs to meet up-to-date energy efficiency requirements for: insulation, vapour barriers, air barriers, mechanical systems, ventilation, attics, foundation walls, drainage, windows, doors and skylights. The specific code proposals and levels of energy efficiency that would be required were based on expert analysis of the potential energy savings, cost, feasibility of implementation and risk of unintended consequences.[86] Of MMAH's respondents to consultation on the retrofit code, 48% supported the potential requirements, 33% would support the potential requirements with modifications, and 19% did not support them.

No progress has occurred regarding these proposals since fall 2017. The Ontario government's draft Environment Plan mentions reviewing the Code to "support the adoption of cost effective energy efficiency measures". MMAH should include a retrofit code to be part of this review.

The ECO recommends that the Ministry of Municipal Affairs and Housing amend the Building Code to include energy efficiency requirements for renovations.

3.3.4 Renovation professionals

Homeowners typically rely on building renovation professionals to provide sound advice and proper execution on retrofit projects. Renovation professionals such as contractors, sub-contractors and registered energy advisors can and should be key channels for homeowners to hear and learn about energy efficiency when they are planning on renovating.

As mentioned previously, 27% of program participants in Enbridge's Home Energy Conservation program heard about it from contractors, the second highest source. In a study by EnerQuality, two thirds of renovators reported that their clients "sometimes" or "very often" ask them about energy efficiency and over half of all renovators felt they have a strong influence on clients incorporating energy efficiency into their projects.[87]

Once familiar with a renovation project, contractors have vital information about potential energy efficiency opportunities. It is important that renovation professionals who are not energy specialists can make homeowners aware of possible energy efficiency upgrades that can be undertaken (e.g. roofers making the connection to insulation services). Improving collaboration between renovation professionals will allow those involved in a renovation to connect with experts that can advise on energy efficiency when relevant. Involving a registered energy advisor, like in Enbridge's program, can provide additional benefits such as impartiality and a holistic energy efficiency focused perspective. Natural Resources Canada's Local Energy Efficiency Partnerships, which partners with the Ontario Home Builders Association, is one example of how to bring additional collaboration to the market.

3

It is vital that the renovation industry has the capacity and incentive to perform high quality envelope renovations.

Deep energy renovations are currently a niche service that needs to develop additional capacity if substantial progress is to be made. Both the availability of qualified professionals and their level of experience currently limit deep energy efficiency renovations. It is vital that the renovation industry has the capacity and incentive to perform high quality envelope renovations. Deep energy renovations to building envelopes are complex, costly projects that can significantly improve the performance of a home. However, if designed or executed improperly, they can waste time and money and/or cause health or safety risks. For example, poorly designed air sealing and high insulation levels can lead to moisture issues that can lead to mould and rotting. This could damage the reputations of not only certain companies and contractors, but also the industry as a whole, and make homeowners wary of undertaking energy retrofits. Each home is different, and expert renovators must address issues from the beginning.

The province should therefore explore how to ensure that renovation professionals have the necessary expertise and diligence. There are two related issues:

- establishing a general level of professionalism in the renovation sector, to ensure that customers have confidence that they will be protected from the risks of poorly done renovations;
- developing the specific knowledge base so that renovators and building officials understand what a good quality envelope renovation looks like.

Training for contractors is crucial to ensuring a successful energy efficiency renovation economy in Ontario.

Photo credit: National Institute of Standards and Technology.

Renomark is an industry-led initiative that is taking initial steps on the first issue, requiring renovators using their trademark to abide by a code of conduct that includes offering warranties, carrying liability insurance, and carrying all applicable licenses and permits as required. The government should examine whether any additional government action is warranted in this area, both to protect consumers and to minimize lost tax revenue from under-the-table renovation work.

The ECO recommends that the Ministry of Municipal Affairs and Housing work with the building industry to increase the industry's capacity to perform and promote high-quality energy efficiency renovations via training, certification, and industry collaboration.

Energy retrofit-specific training on building envelope renovations should cover topics like:
- good insulation levels and air tightness
- proper air and vapour barrier design
- proper installation of components
- minimal thermal bridging
- adequate ventilation to insure proper levels of fresh air and humidity, and
- appropriate cost and timelines.

The Canada Green Building Council has documented what technical skills need to be developed in order to meet the need for low-carbon, energy efficient buildings. Their recommendations include: embedding green building knowledge into curricula; evolving traditional bidding processes and contract models to promote the early involvement of trades; and using green building skills certifications.[88]

The growth of a qualified energy efficient renovation sector could be supported by limiting some of the policy incentives discussed earlier in the chapter (conservation program grants/tax credits and financing programs) to work carried out by appropriately trained or certified renovators. This could also combat the risk of more renovation work moving to the underground economy, which is a significant issue in Ontario.[89]

3.4 Conclusion

Existing homes needlessly consume too much energy, resulting in significant costs to households, the economy and the environment. A decade of energy conservation programs has produced some improvements in home energy efficiency but has largely ignored deep energy efficiency, which almost always involves envelope improvements. Envelope improvements are cheaper and easier if they are added to renovations that are happening anyway, and Ontarians renovate their homes often. Only a small fraction of these planned renovations need to include deep energy renovations each year in order to achieve significant provincial energy savings over time.

The ECO recommends that the government of Ontario slash the energy needed in older homes by improving more building envelopes during planned renovations, by ensuring that:

- **Buyers know the energy use of their potential home, and homeowners have reliable information about the financial and well-being benefits of efficiency improvements.**
  - **The ECO recommends that the Ministry of Energy, Northern Development and Mines promote energy transparency in existing homes by requiring mandatory disclosure of selected home energy information at time of listing.**
- **Efficiency improvements are easy and low-risk for homeowners to finance.**
  - **The ECO recommends that the Ministry of Energy, Northern Developments and Mines and the Ministry of the Environment, Conservation and Parks support and increase the use of third-party financing options for energy efficiency renovations, such as municipal Local Improvement Charge programs, utility on-bill financing, and the use of the Ontario Carbon Trust.**
- **The Building Code sets minimum levels of efficiency in renovated homes.**
  - **The ECO recommends that the Ministry of Municipal Affairs and Housing amend the Building Code to include energy efficiency requirements for renovations.**
- **Renovation professionals have energy efficiency capacity and expertise.**
  - **The ECO recommends that the Ministry of Municipal Affairs and Housing work with the building industry to increase the industry's capacity to perform and promote high-quality energy efficiency renovations via training, certification, and industry collaboration.**

Ontario homes do not need to be energy hogs.

Ontario homes do not need to be energy hogs. From improved comfort to lower utility bills to reduced climate damage, there is a lot to be gained from making renovated homes energy efficient.

Endnotes

1. Ministry of Municipal Affairs and Housing, "Potential Changes to Ontario's Building Code Summer and Fall 2017 Consultation" (presentation, September 2017).
2. Government of Canada, National Energy Board, Provincial and Territorial Energy Profiles – Ontario (22 January 2019), online: <www.neb-one.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/on-eng.html>.
3. Natural Resources Canada, Natural Gas Facts (21 August 2018), online: <www.nrcan.gc.ca/energy/facts/natural-gas/20067#L6>.
4. ECO analysis, see Figure 1.7 in **Chapter 1** of this report.
5. Statistics Canada, Supply and Demand of Primary and Secondary Energy in Terajoules, Annual, Table 25-10-0029-01 (11 February 2019), online: <www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=2510002901>.
6. Statistics Canada, Household Energy Consumption, Canada and Provinces (11 February 2019), online: <www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=2510006001>.
7. National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada, Part 3 (13 April 2018) at 53. (18.8 Mt CO_2e of emissions from residential plus 30% of electricity emissions).
8. While commercial, institutional, industrial, and multi-residential buildings (such as condominiums and rental apartments) also consume a significant amount of energy, and need upgrades to their building envelopes, they differ in many regards from low-rise residential dwellings (e.g. owner-occupant relationship, structural form, etc.). Policy recommendations to improve energy performance in such buildings would be different from those for typical homes.
9. ICF International, Natural Gas Conservation Potential Study, (7 July, 2016), online: <www.oeb.ca/sites/default/files/uploads/ICF_Report_Gas_Conservation_Potential_Study.pdf>. (A much smaller percentage of potential electricity savings (12%) is estimated to come from existing residential buildings (unlike the estimate for natural gas conservation potential, this percentage also includes multi-unit residential buildings). See: Nexant, Achievable Potential Study: Long Term Analysis, (25, November 2016), online: <www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/APS/APS-Long-Term-Analysis-2016-v2.pdf?la=en>.
10. Energy and Mines Ministers' Conference, Build Smart Canada's Buildings Strategy (August 2017), online : <www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/emmc/pdf/Building_Smart_en.pdf>.
11. Natural Resources Canada, Comprehensive Energy Use Database (2019), online: <http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive/trends_res_on.cfm>.
12. Statistics Canada, Survey of Commercial and Institutional Energy Use, 2014 (16 September 2016), online: <www150.statcan.gc.ca/n1/daily-quotidien/160916/dq160916c-eng.pdf>.
13. The remaining 40% of buildings are assumed to be replaced with new buildings by 2050 at a rate of 1.3% per year.
14. There were 74,374 housing completions in 2018 in Ontario. See: Statistics Canada, Canada Mortgage and Housing Corporation, Housing Starts, Under Construction and Completions, All Areas, Quarterly, Table 34-10-0135-01, online: <www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3410013501#timeframe>.
15. In part, this is because Ontario, as well as the Canadian and American federal governments, have minimum energy performance standards for various energy consuming devices such as boilers, air conditioners, and pumps. These performance standards are already fairly stringent and have only moderate room to improve. More details on these standards can be found in ECO's 2016 Energy Conservation Report: Let's Get Serious, online: <docs.assets.eco.on.ca/reports/energy/2015-2016/ECO_Conservation_Lets_Get_Serious-05.pdf>.
16. ICF International, Natural Gas Conservation Potential Study, (7 July, 2016), online: <www.oeb.ca/sites/default/files/uploads/ICF_Report_Gas_Conservation_Potential_Study.pdf>.
17. Financial Accountability Office of Ontario, Home Energy Spending in Ontario: Regional and Income Distribution Perspectives (27 September 2016), online: <www.fao-on.org/en/Blog/Publications/hespending>.
18. Ministry of Energy, Northern Development and Mines, Ontario's Long-Term Energy Plan 2017 Delivering Fairness and Choice (25 October 2017), online: <www.ontario.ca/document/2017-long-term-energy-plan/chapter-1-ensuring-affordable-and-accessible-energy#figure5data>.
19. Ministry of Energy, Northern Development and Mines, Fuels Technical Report (30 November 2017), online: <www.ontario.ca/document/fuels-technical-report/appendix-data-tables#section-32>.
20. Fraser Institute, Energy Costs and Canadian Households: How Much are We Spending? (March 2016), online: <www.fraserinstitute.org/sites/default/files/energy-costs-and-canadian-households.pdf>.
21. International Energy Agency, Capturing the Multiple Benefits of Energy Efficiency (2014), online: <www.iea.org/publications/freepublications/publication/Multiple_Benefits_of_Energy_Efficiency.pdf>.
22. DNV-GL, 2016 Natural Gas Demand-Side Management Annual Verification (30 October 2018), online: <www.oeb.ca/sites/default/files/OEB-2016-Natural-Gas-DSM-Annual-Verification-Report-20181030-2.pdf>.
23. in terms of percentage of participants that implemented them.
24. Lio & Associates, Determining How to Effectively Require Energy Efficiency Upgrades at Time of Renovation (22 March 2013).
25. Residential savings accounted for 46% of all savings. The Coupon and Instant Discount program accounted for 740 GWh of residential savings and LED light bulbs accounted for 91% of those savings. See: IESO, 2017 Final Verified Annual LDC CDM Program Results Report (29 June 2018), online: <www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/LDC-results/2017/2017-Final-Verified-Annual-LDC-CDM-Program-Results-Province-Report-20180629.xlsx?la=en>.
26. IESO, 2017 Report on Energy-Efficiency Activities (19 December 2018), online: <http://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation-reports/Annual/2017-report-on-energy-efficiency.pdf?la=en>.
27. The five programs are Instant Discounts, Heating and Cooling, Smart Thermostats, Residential New Construction, and the Home Assistance Program. The Home Assistance Program is only eligible for low-income households and includes weatherization measures where eligible.
28. Overall, these programs accounted for 19% of the overall gas savings by Enbridge and Union Gas in 2016.
29. In 2016, there were 12,986 participants in Enbridge's program, which is less than 1% of Enbridge's total residential customers. Union Gas' Home Reno Rebate program had only 6,595 participants in 2016, or 0.5% of their total residential customers.

30. Environmental Commissioner of Ontario, Climate Action in Ontario: What's Next?, Annual Greenhouse Gas Progress Report – 2018, Appendix B (Toronto: ECO, September 2018), online: <docs.assets.eco.on.ca/reports/climate-change/2018/Climate-Action-in-Ontario-Appendix-B.pdf>.

31. The remaining GGRA funds were allocated to social housing, businesses, transportation initiatives, and public sector institutions. A detailed breakdown can be found in Appendix B of ECO's 2018 Climate Change report. See: Environmental Commissioner of Ontario, Climate Action in Ontario: What's Next?, Annual Greenhouse Gas Progress Report – 2018, Appendix B (Toronto: ECO, September 2018), online: <docs.assets.eco.on.ca/reports/climate-change/2018/Climate-Action-in-Ontario-Appendix-B.pdf>.

32. There were 11,181 participants in Enbridge Gas' program, 11,514 participants in Union Gas' program, and 2,521 participants under the Greenhouse Gas Reduction Account. See: Enbridge Gas Distribution Limited, Green Investment Fund Monthly Report #10 Period Ending November 30, 2018, at 2; Union Gas, Monthly Report – October 2018 Green Investment Fund Greenhouse Gas Reduction Account, at 3.

33. CADMUS, Whole Home Pilot Evaluation 15 November 2018), online: <www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2017/2017-Whole-Home-Pilot-Evaluation-Report.pdf?la=en> at 14. (These percentages include retrofits funded through gas utility programs, through the Green Investment Fund/Greenhouse Gas Reduction Account, and through the IESO).

34. CADMUS, Whole Home Pilot Evaluation 15 November 2018), online: <www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2017/2017-Whole-Home-Pilot-Evaluation-Report.pdf?la=en>.

35. $1,000 for saving 15-24%, $1,600 for saving 25-49%, and $2,100 for saving 50% or more.

36. The qualifying upgrades and products included: attic insulation; wall insulation; basement wall insulation; exposed floor insulation; air sealing (at least 10% reduction in leakage as determined by blower door test); window replacements; high-efficiency space heating system; high efficiency water heating system; and drain water heat recovery system.

37. Ministry of Municipal Affairs and Housing, "Potential Changes to Ontario's Building Code Summer and Fall 2017 Consultation" (presentation, September 2017).

38. DNV-GL, 2016 Natural Gas Demand-Side Management Annual Verification (30 October 2018), online: <www.oeb.ca/sites/default/files/OEB-2016-Natural-Gas-DSM-Annual-Verification-Report-20181030-2.pdf>.

39. This is simply assuming that the 17% of Enbridge customers that did not do only a furnace and air sealing did add insulation which is still very optimistic.

40. CIBC, Canadian Homeowners Trim Spending on Home Renovations in 2018 (31 May 2018) online: <www.newswire.ca/news-releases/canadian-homeowners-trim-spending-on-home-renovations-in-2018-cibc-poll-684137711.html>.

41. Statistics Canada, Residential Construction Investment, Table: 34-10-0010-01 (11 February 2019), online: <www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3410001001>.

42. If each renovation on average cost $13,600 and Ontarian's spent $24 billion then approximately 1.7 million renovations take place each year. Only 4.3% of these renovations need to include deep energy retrofits in order to have 60% of homes be highly energy efficient by 2050.

43. TrustedPros, Top 10 Home Renovations in Canada for 2016, online: <trustedpros.ca/articles/general/top-10-home-renovations-in-canada-for-2016>. (The 12% is from windows and doors and roofing (6% each). 15% of renovations were basement renovations, some of which could also provide an opportunity for an envelope upgrade. Renovations to walls (e.g. siding replacement) were either not an option on the survey, or were not in the top 10 responses.)

44. The archetype home was a typical two-storey home built in the 1980's, had approximately 2,000 ft^2 of interior space, and typical insulation and airtightness values for homes at the time.

45. DryVit, "Exterior Retrofit Insulation System for Above Grade Walls in Southwestern Ontario", (presentation delivered at Natural Resources Canada LEEP Forum Building Envelope, 14 November 2018).

46. Now House, The First Now House, online: <www.nowhouseproject.com/workDemoResults.php>.

47. CMHC, Testing Different Approaches to Energy Reduction in Five 1½-Storey Post-War Houses (December 2011), online: <www.windsor5.com/media/CMHC-Technical-Series_Nov-2012.pdf>.

48. Now House, "Net Zero Energy home Retrofits", (presentation, 21 January 2019).

49. CADMUS, Whole Home Pilot Evaluation 15 November 2018), online: <www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2017/2017-Whole-Home-Pilot-Evaluation-Report.pdf?la=en>.

50. Ministry of Energy, Northern Development and Mines, information provided to the ECO in response to ECO inquiry, 15 January 2019.

51. The Nonbusiness Energy Property Tax Credit covers measures such as heat pumps, water heaters, and furnaces with the tax credit ranging from 10-30% of the cost, and with a total credit cap ranging from $500-$1500 per lifetime. The Residential Energy-Efficient Property Tax Credit covers measures such as solar PV, and solar hot water with a tax credit of 30% of the cost, diminishing to 26% in 2020 and 22% in 2021.

52. Congressional Research Service, Residential Energy Tax Credits: Overview and Analysis (9 April 2018), online: <fas.org/sgp/crs/misc/R42089.pdf>.

53. 16% of US home owners renovate after they've just bought/moved in. See: Empire Today, "Home Renovation Survey Find Unique Trends Among U.S. Homeowners, online: <www.empiretoday.com/home-renovation-survey>.

54. For additional analysis and context, see: Consumers Council of Canada, Mandatory Home Energy Rating and Disclosure for Existing Houses: Opportunities and Risks for Consumers (March 2018), online; <www.consumerscouncil.com/site/consumers_council_of_canada/assets/pdf/810796_ccc_energy_rating_report_english_web.pdf>; Massachusetts Institute of Technology, A New Model for Disclosing the Energy Performance of Residential Buildings (March 2012), online: <web.mit.edu/energy-efficiency/docs/EESP_Nadkarni_BuildingPerformanceDisclosure.pdf>.

55. Consumers Council of Canada, Mandatory Home Energy Rating and Disclosure for Existing Houses: Opportunities and Risks for Consumers (March 2018), online; <www.consumerscouncil.com/site/consumers_council_of_canada/assets/pdf/810796_ccc_energy_rating_report_english_web.pdf>.

56. Consumers Council of Canada, Mandatory Home Energy Rating and Disclosure for Existing Houses: Opportunities and Risks for Consumers (March 2018), online; <www.consumerscouncil.com/site/consumers_council_of_canada/assets/pdf/810796_ccc_energy_rating_report_english_web.pdf>.

57. Alex J Hill et al, "Predicting Home Energy Rating and Disclosure Program Impacts for North American Jurisdictions" (2016), online: <aceee.org/files/proceedings/2016/data/papers/7_218.pdf>.

58. Alex J Hill et al, "Predicting Home Energy Rating and Disclosure Program Impacts for North American Jurisdictions" (2016), online: <aceee.org/files/proceedings/2016/data/papers/7_218.pdf>.

59. Ministry of Energy, Northern Development and Mines, Ontario's Long-Term Energy Plan 2017 Delivering Fairness and Choice (25 October 2017), online: <files.ontario.ca/books/ltep2017_0.pdf> at 100.

60. Ministry of Energy, Northern Development and Mines, information provided to the ECO in response to ECO inquiry, 15 January 2019.

61. Enbridge Gas Distribution Inc., Application for 2015 Demand Side Management ("DSM") Clearance of Deferral and Variance Accounts (19 December 2017), online: <http://www.rds.oeb.ca/HPECMWebDrawer/Record/594277/File/document>.

62. Deborah Philbrick, Rachel Scheu & John Blaser, Moving the Market: Energy Cost Disclosure in Residential Real Estate Listing (2016), online: <www.elevateenergy.org/wp/wp-content/uploads/Moving-the-Market_-Energy-Cost-Disclosure-in-Residential-Real-Estate-Listings.pdf>.

63. Deborah Philbrick, Rachel Scheu & John Blaser, Moving the Market: Energy Cost Disclosure in Residential Real Estate Listing (2016), online: <www.elevateenergy.org/wp/wp-content/uploads/Moving-the-Market_-Energy-Cost-Disclosure-in-Residential-Real-Estate-Listings.pdf>.

64. IESO undertook a social benchmarking pilot in 2014 for 18 months and found energy savings to be measurable but minor. Mail delivery of the social benchmarking resulted in lower customer satisfaction but greater customer recall of energy saving tips. See: Nexant, Social Benchmarking Pilot Evaluation (7 November 2016), online: <www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2016/2016-Social-Benchmarking-Final-Report.pdf?la=en>.

65. Tools such as Toronto 2030 Platform (toronto2030platform.ca/) and MyHeat (myheat.ca) can also be readily used to help residents see, understand, and compare energy use.

66. Stephane de La Rue du Can et all, Design of Incentive Programs for Accelerating Penetration of Energy-Efficient Appliances (September 2014), online: <www.sciencedirect.com/science/article/pii/S0301421514002705>.

67. Brennan Less & Iain Walker, Deep Energy Retrofit Guidance for the Building America Solutions Center (2015), online: <eta.lbl.gov/sites/all/files/publications/brennan_less_-_deep_energy_retrofit_guidance_for_the_building_america_solutions_center.pdf>.

68. Enbridge offers a service called Open Bill Access which enables third party businesses to bill customers through Enbridge's billing system. However, the financing of the capital cost for any of these services is not handled by Enbridge.

69. Ontario Energy Board, Applications for Approval of 2015-2020 Demand Side Management Plans, EB-2015-0029/EB-2015-0049, (OEB, 20 January, 2016) at 54.

70. Aside from single-family homes, OBF could potentially be applicable in the rental and high-rise building sectors.

71. Ontario Energy Board, Mid-Term Review of the Demand Side Management Framework for Natural Gas Distributors, EB-2017-0127/0128 (Toronto: OEB, November 2018) at 54-55.

72. SEE Action, "Financing Energy improvements on Utility Bills Technical Appendix – Case Studies" (May 2014), online: <www4.eere.energy.gov/seeaction/system/files/documents/publications/chapters/onbill_financing_appendix.pdf>.

73. Pacific Institute for Climate Solutions, "Cheaper Power Bills, More Jobs, Less CO2: How On-Bill Financing Done Right can be a Quick Win for British Columbia" (September 2015), online: <pics.uvic.ca/sites/default/files/uploads/publications/On-Bill%20Financing%20FINAL.pdf>.

74. Manitoba Hydro, call with the ECO (September 14, 2018).

75. Manitoba Hydro, call with the ECO (September 14, 2018).

76. Manitoba Hydro, call with the ECO (September 14, 2018).

77. City of Toronto, Home Energy Loan Program and High-Rise Retrofit Improvement Support Program Evaluation (21 March 2017), online: <www.toronto.ca/legdocs/mmis/2017/pe/bgrd/backgroundfile-102272.pdf>.

78. Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations A Made-in-Ontario Environment Plan (December 2018) at 27.

79. Ministry of Energy, Northern Development and Mines, information provided to the ECO in response to ECO inquiry, 15 January 2019.

80. DBRS, "DBRS Publishes Commentary on Residential PACE Delinquency Trends" (22 February 2018), online: <www.dbrs.com/research/323286/dbrs-publishes-commentary-on-residential-pace-delinquency-trends>.

81. City of Toronto, Home Energy Loan Program and High-Rise Retrofit Improvement Support Program Update (19 April 2018), online: <www.toronto.ca/legdocs/mmis/2018/pe/bgrd/backgroundfile-114375.pdf>.

82. The Ontario Building Code currently requires additions generally to be built to current energy efficiency levels.

83. City of Vancouver, "Energy Requirements for Single Family Home Renovations" (2018), online: <vancouver.ca/home-property-development/energy-requirements-for-single-family-home-renovations.aspx>.

84. Lio & Associates, Determining How to Effectively Require Energy Efficiency Upgrades at Time of Renovation (22 March 2013)

85. The proposed changes clarify that with respect to energy efficiency, material alternations or repair include activities such as: removal of most of the drywall on an exterior wall exposing most of the stud cavities; removal of most of the exterior cladding such that large areas are re-cladded; converting an roof from a vented open attic to a conditioned space; or replacing building equipment or components such as an HVAC system.

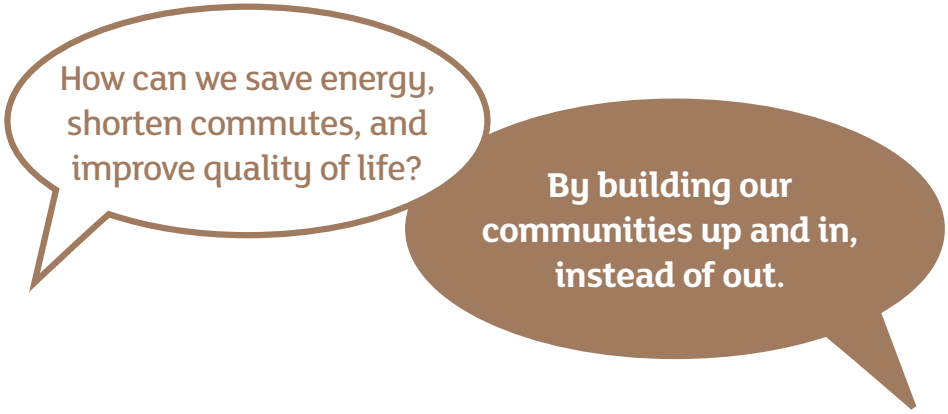
86. Ministry of Municipal Affairs and Housing, information provided to the ECO in response to ECO inquiry, January 2019.

87. EnerQuality, e-mail with the ECO (February 15, 2019).

88. CaGBC, "Trading Up Equipping Ontario Trades with Skills of the Future" (29 January 2019), online: <www.cagbc.org/cagbcdocs/advocacy/CaGBC_Trading_Up_Skills_Analysis_Report_2019.pdf>.

89. Altus Group, "Combating Ontario's Undeground Economy in the Residential Renovation Sector and Reducing GHG Emissions Through Innovative Policies (November 2017), online: <www.ohba.ca/altus-report-combating-ontarios-underground-economy-residential-renovation-sector-reducing-ghg-emissions-innovative-policies/>.

4. Urban sprawl: the road to gridlock



Abstract

Ontario is a large province. Petroleum products used for transportation are our largest and fastest-growing energy sources, create more than one-third of our climate pollution, have a high economic price and adversely affect human health. Ontario's heavy dependence on fossil-fuelled vehicles, fed by low-density urban development, is putting us squarely on the road to gridlock, with high costs in congestion, lost productivity, and air pollution, while destroying the agricultural land and natural heritage areas upon which we depend.

Ontarians drive a lot, because the places we need to go are spread out. Most Ontarians live inconveniently far from grocery stores, libraries, schools, and jobs. Many individuals would prefer not to spend hours a day in their car, but because of government decisions about land use and transportation they often have few viable alternatives. These decisions lock people into a harmful feedback cycle of car dependency and ever longer, more congested commutes.

Current government policies and proposals will make these problems worse. The province's Growth Plan for the Greater Golden Horseshoe claims it will accommodate the rapidly growing population in compact, complete communities that give residents a better quality of life. Instead, the Plan increases costly urban sprawl, by directing hundreds of thousands of people to new, distant suburbs with high servicing costs, few employment opportunities, and too little density to support public transit. Proposed amendments to the Growth Plan will spread new suburbs over more agricultural land, forests and wetlands. This will drive up climate and air pollution, reduce resilience to floods, increase costs for municipalities, and lock future residents into long, difficult, expensive and congested commutes.

Ontario can and should accommodate its growing population (a 30% increase by 2041) without creating further urban sprawl and gridlock. There is room to add the right housing supply in the right locations – creating compact, complete communities with access to jobs and transit, while revitalizing the inner suburbs and other built-up areas that today are stagnant or losing population. Building a greater mix of housing in existing areas can shorten commutes, reduce fossil fuel use, help address high living costs, and protect natural areas and farmland.

Contents

4.1 Introduction

Cars, SUVs, and light trucks (hereafter referred to as "cars") are an important part of the modern economy. For the past half century or more, cars have brought many benefits – greater freedom of movement and connecting people to each other and to jobs and services.

Cars produce 32 million tonnes of climate pollution each year – similar to Ontario's heavy industry and buildings sectors.

But cars have also brought heavy costs, including air pollution, collisions causing injury and death, traffic congestion, inefficient land use, and rising energy use and greenhouse gas (GHG) emissions. Ontario's transport sector is almost entirely fossil-fuel dependent, and is responsible for around 35% of the province's GHG emissions. Cars alone produce almost 32 million tonnes of climate pollution each year – similar to Ontario's heavy industry and buildings sectors (Figure 4.1).

Ontarians have generally accepted the trade-offs between the benefits and costs of cars. Increasingly, however, the growing impacts of our dependency on fossil-fueled cars has focused attention on their costs. A growing number of people, cities, and even countries are taking steps to reduce car use and promote low-carbon alternatives.

At the same time, travel trends are changing across the developed world, calling into question many of the assumptions on which decision makers have based their policies and investments. Across Europe, Australia and North America, research is pointing to a decrease in the number and length of trips (i.e., the demand for travel), a decline in car ownership and drivers' licences, and a demographic shift in the way people travel.

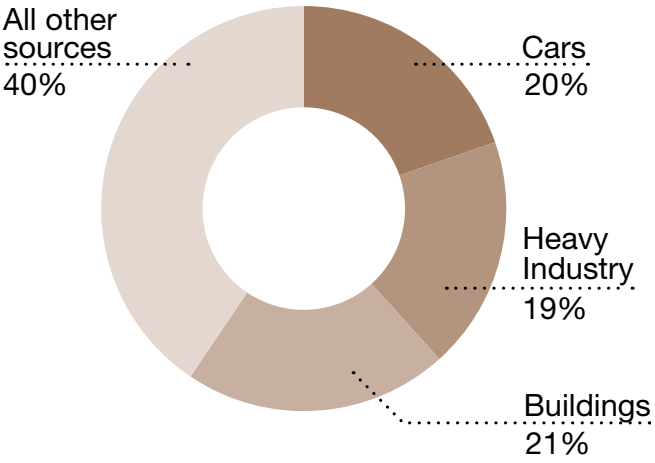


Figure 4.1. Ontario's greenhouse gas emissions in 2016. Cars, SUVs and light trucks produce similar GHG emissions to Ontario's heavy industry and buildings. Emissions from cars grew 35% from 1990 to 2016, while buildings increased 21% and industry reduced emissions by 30%.

Source: Environment and Climate Change Canada, National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada (2018), Table A12-7.

This chapter looks at how and why people travel in Ontario, and explores how government policies can reduce congestion, cut emissions, and encourage people to take more efficient modes of transport. Its focus is on passenger road travel, as freight is a topic on which the ECO has recently reported.[1] This chapter focuses on how good land use planning can reduce total car travel (generally measured as vehicle-kilometres travelled (VKT) or passenger-kilometres (PKM)). Land use is an important lever that the provincial and municipal governments could use to reduce car travel. Doing so would bring tangible benefits: cleaner air, more vibrant communities, a healthier population, and more efficient public spending – to name just a few. Inaction will result in more congestion, longer commutes, and continued loss of productive farmland.

Good land use planning can reduce total car travel.

How efficient are cars compared to other modes of transport?

There is large variation between the efficiency (in energy and space terms) of different modes of transportation. Because cars generally carry few passengers (average occupancy in the Greater Toronto Area is about 1.1 people/vehicle), they tend to be less energy efficient than public transit, despite the fact that more energy is required to power a bus or train.

For example, an efficient midsize car (e.g., Toyota Prius) uses about 1.65 mega-joules (MJ) of energy per passenger-kilometre (PKM). A station wagon or SUV uses 2.5-3 MJ/PKM, while a pickup truck (e.g., Ford F-150, the best-selling vehicle in Canada) uses up to 4.6 MJ/PKM.

By comparison, a diesel bus running at capacity (50 riders) uses about 0.24 MJ/PKM; light rail transit (~200 riders) uses 0.07 MJ/PKM; and a full subway train (1,100 riders) or GO Train (1,944 riders) uses 0.05 MJ/PKM. In other words, transit ranges from 10–50 times more energy efficient than driving. Even at lower capacities – such as in low-density areas or during off-peak times – transit generally outperforms private cars.[2]

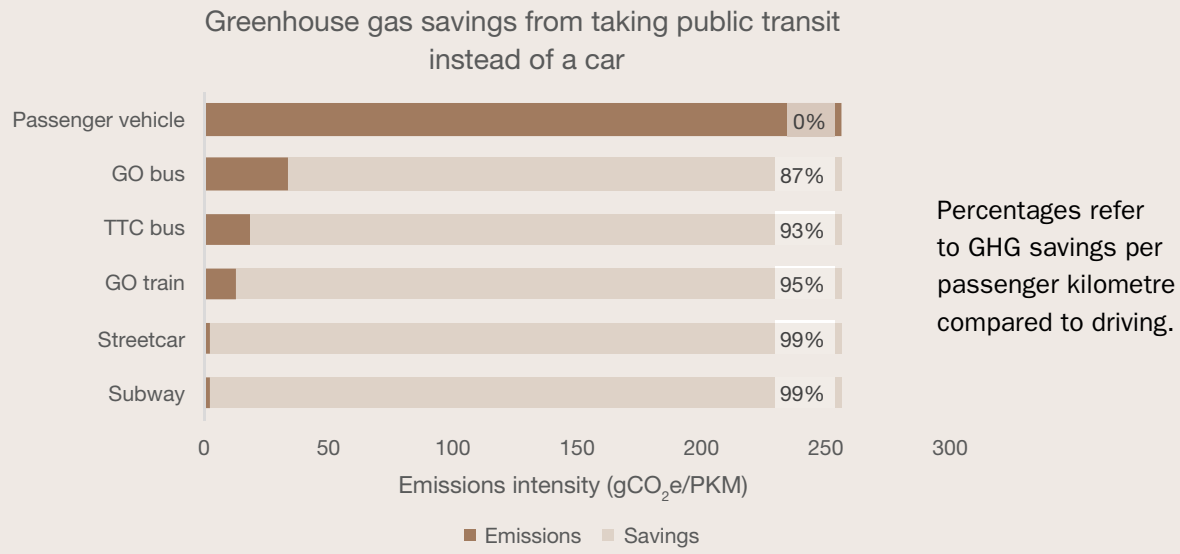
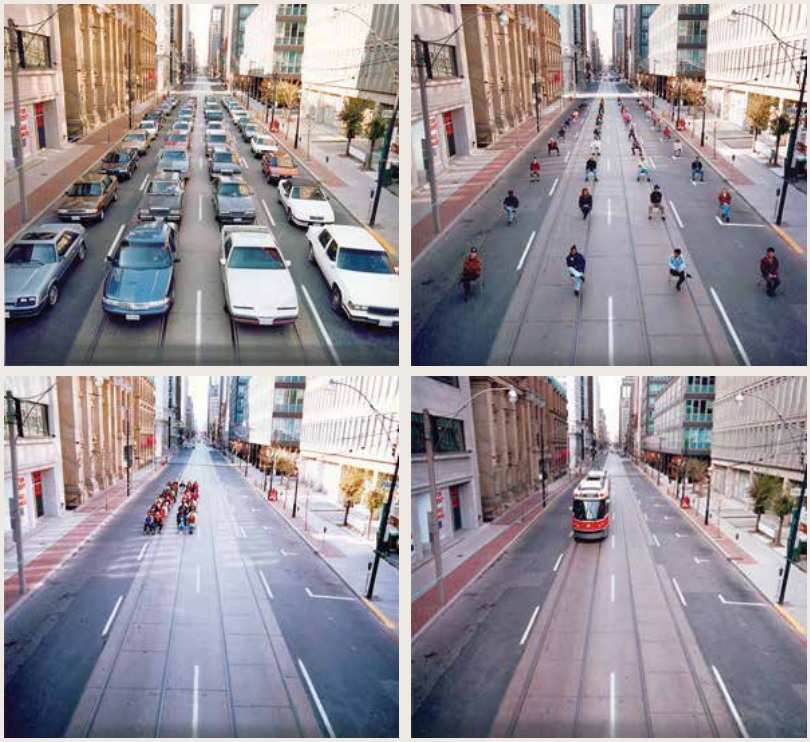


Figure 4.2. The percentage GHG savings per passenger-km (PKM) for various modes of public transit, compared to passenger vehicles. Emissions intensities are based on average vehicle occupancies in the Toronto census metropolitan area.

Source: An Wang et al., "Automated, electric, or both? Investigating the effects of transportation and technology scenarios on metropolitan greenhouse gas emissions" (2018) 40 Sustainable Cities and Society 524

Shifting people from cars to transit can translate into large GHG reductions. Toronto Transit Commission (TTC) subways and streetcars in are around 100 times less GHG-intensive than cars, in part because they take advantage of Ontario's low-carbon electricity grid. Diesel-powered GO Trains and TTC/GO buses also emit far fewer GHGs than cars (Figure 4.2).

Public transit, walking and cycling also frees up scarce road space. The TTC estimates that a full streetcar takes 55 cars off the road, and a full subway displaces 1,000 cars.[3] Converting an arterial car lane to a bus rapid transit lane can move 20-30 times as many people per hour; even sidewalks and bicycle lanes move 5-10 times as many people each hour (with zero emissions).[4]



A full streetcar can carry as many people as 55 cars, making far more efficient use of energy and limited street space.

Photo credit: Toronto Transit Commission.

4.2 Transportation and land use in Ontario

4.2.1 Ontarians are driving more than ever

In 2016, Ontarians drove 227 billion passenger-kilometres (PKM).[5] Daily per capita vehicle travel was 44.6 km, higher than the Canadian average of 41.1 km. Since 1990, there has been a significant increase in total PKM (Figure 4.3) which has grown faster than population; per capita road travel in 2016 was 10% higher than in 1990. Over this period there has been huge growth in the use of trucks and SUVs – in 2016 these accounted for over 100 billion passenger-kilometres, a 380% increase from 1990 – while there has been a slight decrease in travel by smaller cars.

Per capita road travel in 2016 was 10% higher than in 1990.

Improvements in vehicle efficiency and lower-emission fuels did little to offset the large growth in vehicle use.

As a result of the growth in car travel, Ontario's energy use for passenger road transport (which is almost entirely fossil-fuelled) increased 22% from 1990 to 2016. This has led to increasing GHG emissions as well as local air pollution. Improvements in vehicle efficiency and lower-emission fuels over the same period – due to federal standards, ethanol-blending requirements, and higher fuel prices – did little to offset the large growth in vehicle use (Figure 4.4). There has also been a shift from passenger cars to trucks, minivans and SUVs, which made up 66% of the market in 2017 (up from 51% in 2012).[6]

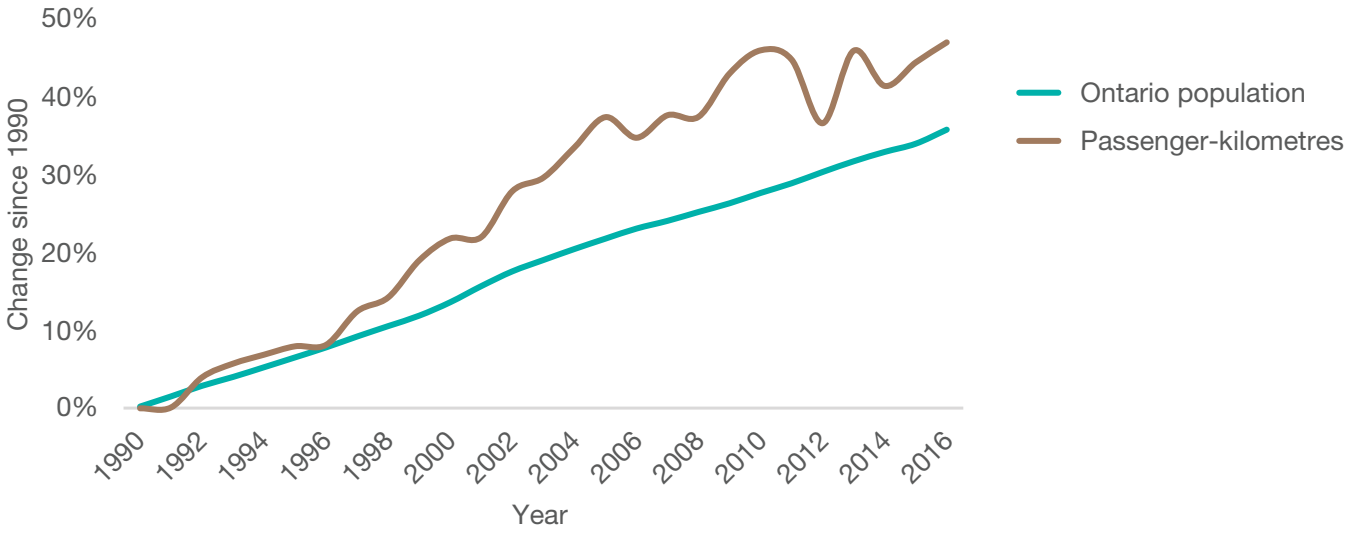


Figure 4.3. The change in Ontario's population and passenger road travel (in passenger-kilometres) between 1990 and 2016. Total road travel increased by 47%, outpacing the 36% growth in population.

Source: Natural Resources Canada, Comprehensive Energy Use Database, Transportation Sector – Ontario, Table 10: Passenger Road Transportation Secondary Energy Use and GHG Emissions by Energy Source.

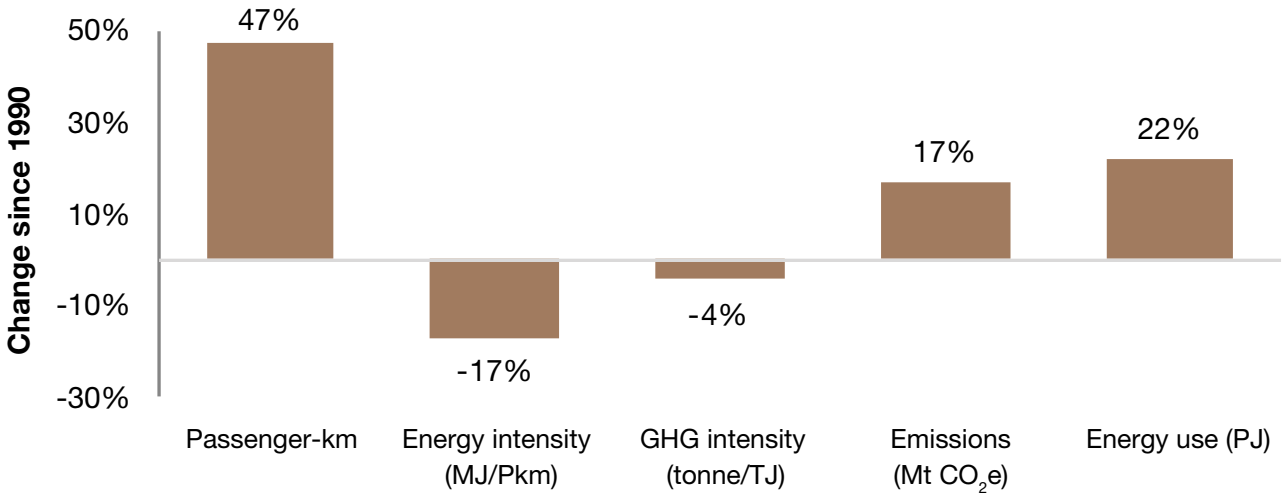


Figure 4.4. The increase in GHG emissions and energy use from cars and passenger trucks between 1990 and 2016 has largely been driven by an increase in vehicle use (passenger-km), which has been slightly offset by lower energy and fuel GHG intensities. MJ = megajoules; Pkm = passenger-km; TJ = terajoules; Mt CO_2e = megatonnes of carbon dioxide equivalent.

Source: Natural Resources Canada, Comprehensive Energy Use Database, Transportation Sector – Ontario, Tables 10, 20, and 25.

The growth in energy use and emissions would have been even higher if not for an 8% drop in per capita road travel since 2010. A number of other countries (including the U.S., U.K., Germany, France and Australia) have experienced steep declines in per capita car travel starting in the early-2000s.[7] The reasons for this are not well understood. Many explanations have been proposed: young people choosing not to drive; migration into cities; economic factors; more people working from home; and the growth of social media and online shopping. It is too early to say whether Ontario is also experiencing a similar trend or whether the post-2010 decline is a blip.

The vast majority of Ontarians still use cars to get from A to B. According to the 2016 Census, 78% of Ontarians commute by car, while 14.6% use public transit and 6.5% walk or cycle (Figure 4.5).[8] These proportions have shown little change in the last two decades, despite large investments in public transit. Although car mode share is highest in rural areas, many suburban areas are also highly car-dependent, with 80-90% of trips made by car. Only some downtown urban areas have lower car mode share and higher rates of public transit and active transportation.

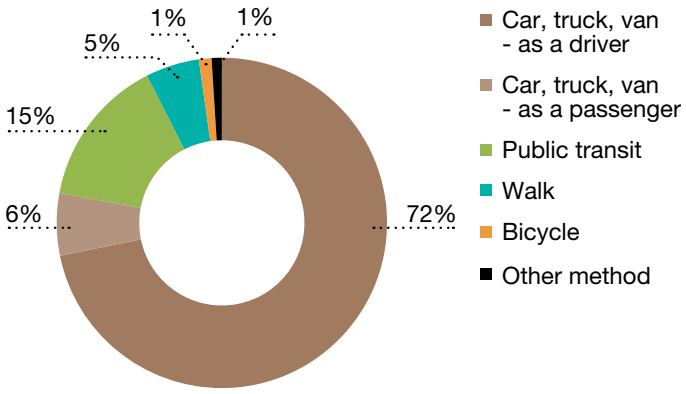


Figure 4.5. The proportion of people commuting by different transport modes in 2016. Since 1996 the proportion of people using cars has slightly decreased, from 80% to 78% in 2016. The proportion using more sustainable transport options (public transit, walking and cycling) has risen from 19% to 21%. 'Other method' includes motorcycles, scooters, mopeds, taxis, school buses, and ferries.

Source: Statistics Canada, Census Profile, 2016 Census, Ontario – Journey to work (Ottawa: Statistics Canada, 2016).

4.2.2 Land use is a key factor in why Ontarians drive so much

Why do 78% of Ontarians commute by car? Why do Ontarians drive more than 16,000 km per year on average? Although there are many factors in why people choose to drive (see textbox "Why do people drive?"), one of the most important is land use. Distance between destinations, population density, the mix of uses, local street design and other land use factors strongly influence whether people choose to drive, and how far and often they travel. In simple terms, these land use patterns can be grouped into either "sprawl" or "compact growth" (Table 4.1).

Why do 78% of Ontarians commute by car? One of the most important factors is land use.

Table 4.1. Examples of how land use factors influence transportation patterns under sprawl or compact growth patterns.

Land use factor	Sprawl	Compact Growth
Density	Low densities and dispersed activities encourage car use over public transit	Higher densities and clustered activities support public transit
Scale	Large scale, wide roads, large blocks, streetscapes lack detail	Shorter blocks, smaller roads, more intersections, human-scaled streetscapes
Land use mix	Single uses separated by large distances	Mix of uses (residential, retail, employment, amenities, etc.)
Street design	Prioritize motor vehicle volume and speed	Complete streets that accommodate diverse modes (e.g., walking and cycling)
Connectivity	Disconnected roads and walkways, difficult to travel directly on foot	Highly connected roads, sidewalks and paths allowing direct travel on foot
Public space	Emphasis on private realms (e.g., yards, malls, gated communities)	Emphasis on public realm (e.g., parks, markets, shopping streets)

Source: Adapted from Table 1 in Todd Litman, Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl (London: LSE Cities, 2015).

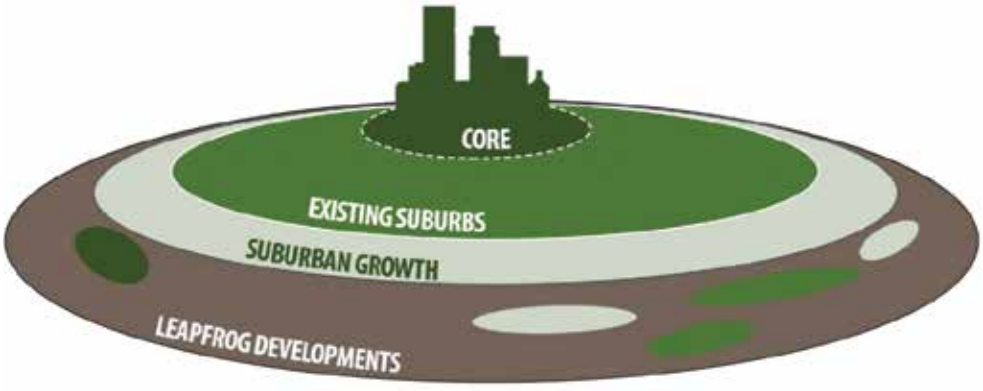


Figure 4.6. The urban-suburban-exurban structure.

Source: Smart Prosperity Institute, Suburban Sprawl: Exposing Hidden Costs, Identifying Innovations (2013).

Most Ontarians live in sprawling automobile-dependent communities. In 2016, more than 8.5 million people lived in suburbs or "exurbs" (low-density areas beyond suburbs) where densities are too low to support transit, and cars are the predominant mode of transport. This is three times the population (2.7 million) who live in walkable urban cores, or older "transit suburbs" where car use is lower (Figure 4.7).

Most Ontarians live in suburbs where densities are too low to support transit.

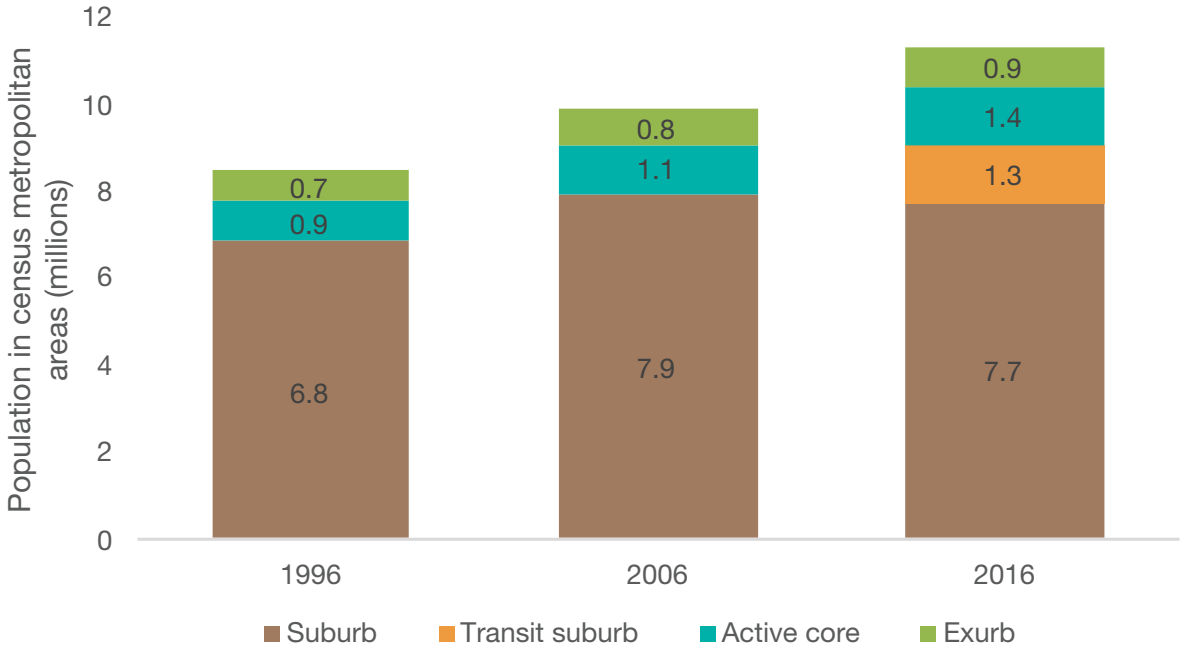


Figure 4.7. The population of 16 Ontario Census Metropolitan Areas (CMAs) in 1996, 2006, and 2016, who live in suburbs, transit suburbs, active cores, and exurbs. Suburbs are defined as areas with low active transit and a high rate of automobile use. Transit suburbs are areas with average rate of transit use 1.5 times higher than the overall average for the CMA (data is only available for 2016). Active cores are areas with an average rate of walking and cycling 1.5 times higher than the overall average for the CMA. Exurbs are areas that have low density and mostly depend on automobile use. The total population of the 16 CMAs in 2016 was 11.3 million, or 84% of Ontario's population.

Source: David Gordon, "Canadian Suburbs, Canadian Census Metropolitan Areas", Core / Suburbs / Exurban Proportions, 1996, 2006 and 2016 Census, Model T8/T9, online: Queen's University <https://canadiansuburbs.ca/suburbsdata.html> [Accessed January 15, 2019].

Urban density strongly affects per capita energy use and greenhouse gas emissions.

Extensive research shows that urban density strongly affects per capita energy use and GHG emissions. For example, in the Greater Toronto Area residents of low-density suburbs have significantly higher per capita GHG emissions from transportation, home heating and electricity than residents in higher-density urban areas (Figure 4.9).[9] Other studies have found that people who live in higher density areas have lower transportation-related energy use, car travel, commute times, energy costs, and air pollution.

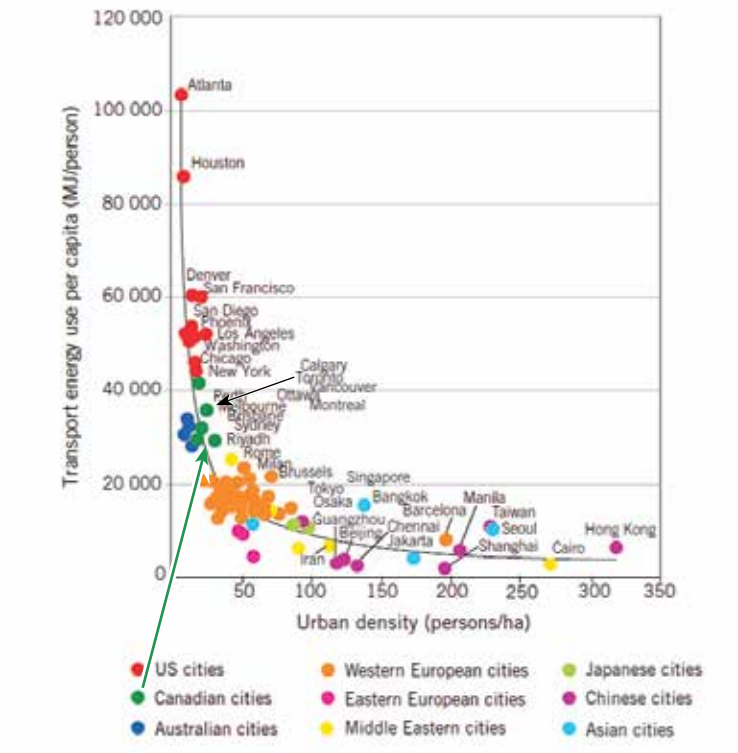


Figure 4.8. Urban density shows a strong negative relationship with per capita transport energy use, across cities and regions. North American cities tend to have lower densities and higher per capita energy use than cities in Europe and Asia.

Source: International Association of Public Transport Providers (2005).

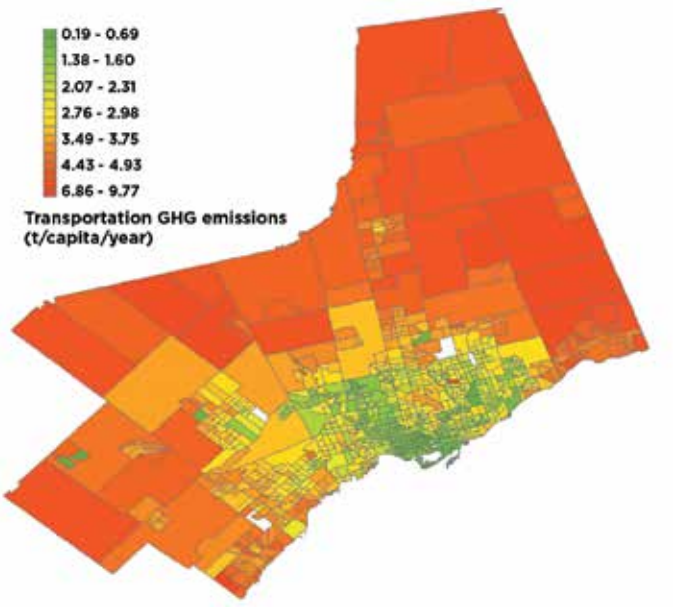


Figure 4.9. Per capita annual transportation greenhouse gas emissions in the Toronto Census Metropolitan Area (includes private automobiles and public transit). Emissions can vary by at least a factor of ten based on residents' location, transportation options, and urban density.

Source: Jared VandeWeghe and Christopher Kennedy, "A Spatial Analysis of Residential Greenhouse Gas Emissions in the Toronto Census Metropolitan Area" (2007) 11:2 Journal of Industrial Ecology 133-144.

Why do people drive?

Beyond the land use factors described above, people choose to drive for a number of reasons. These include household size/incomes, fuel prices, age, employment, and gender. Driving is often seen as more convenient and comfortable than alternatives due to extensive, low-cost road networks and parking.

Recent trends are disrupting these traditional factors. In some countries, younger people are driving less and/or later, the gender gap is closing, and baby boomers are driving more compared to previous generations. These are likely due to social changes, such as economic insecurity (e.g., the growth of the "gig economy"),

changes in living situations (e.g., lower home ownership, re-urbanization), and delays in life events (e.g., marriage, starting families).

The rise in online shopping and interactions are also reducing the need to travel, and car-sharing or ride-hailing services have the potential to displace car ownership. However, new technologies could also increase car travel. Evidence from cities in the U.S. suggests that ride-hailing companies have increased congestion and car travel by an estimated 5.7 billion miles per year.[10] Automated vehicles have been tested in Ontario since January 2016, and level 3 automated vehicles can now be driven by members of the public. Unless they are properly integrated with existing public transit systems, these vehicles could encourage longer commutes and more road congestion.

Hamilton's SoBi bike share scheme is a popular choice for shorter trips.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

4.2.3 Government policies influence our transportation choices

Ontario's land use – and the resulting transportation patterns – were largely driven by government policies. Provincial and municipal planning decisions, infrastructure and transportation investments, and pricing policies have all played a role in creating communities where people have few options other than to drive.

Since 1971, the Greater Toronto and Hamilton Area has more than doubled its urban footprint, largely by building low-density suburbs on prime agricultural land (Figure 4.10). Despite substantial variation, density in the region has decreased over time. Many developments from the 1980s and 1990s are built at lower densities than pre-war communities,[11] although some recent greenfield developments are being planned at higher densities (although still largely oriented around cars).

Since 1971, the Greater Toronto and Hamilton Area has more than doubled in size, largely by building low-density suburbs on prime agricultural land.

The expansion of roads and highways both facilitated, and resulted from, this urban expansion. As new car-dependent suburbs were built, more roads were constructed to accommodate increased car ownership and travel. These new roads induced further travel demand and became congested, creating pressure to further expand roads and create more suburbs. Furthermore, the underpricing of roads and low-density development (e.g., through free parking, lack of road pricing, low fuel taxes, development charges and more) makes this type of development appear cheap, when in fact it carries significant external costs (see text box "The hidden costs of sprawl").

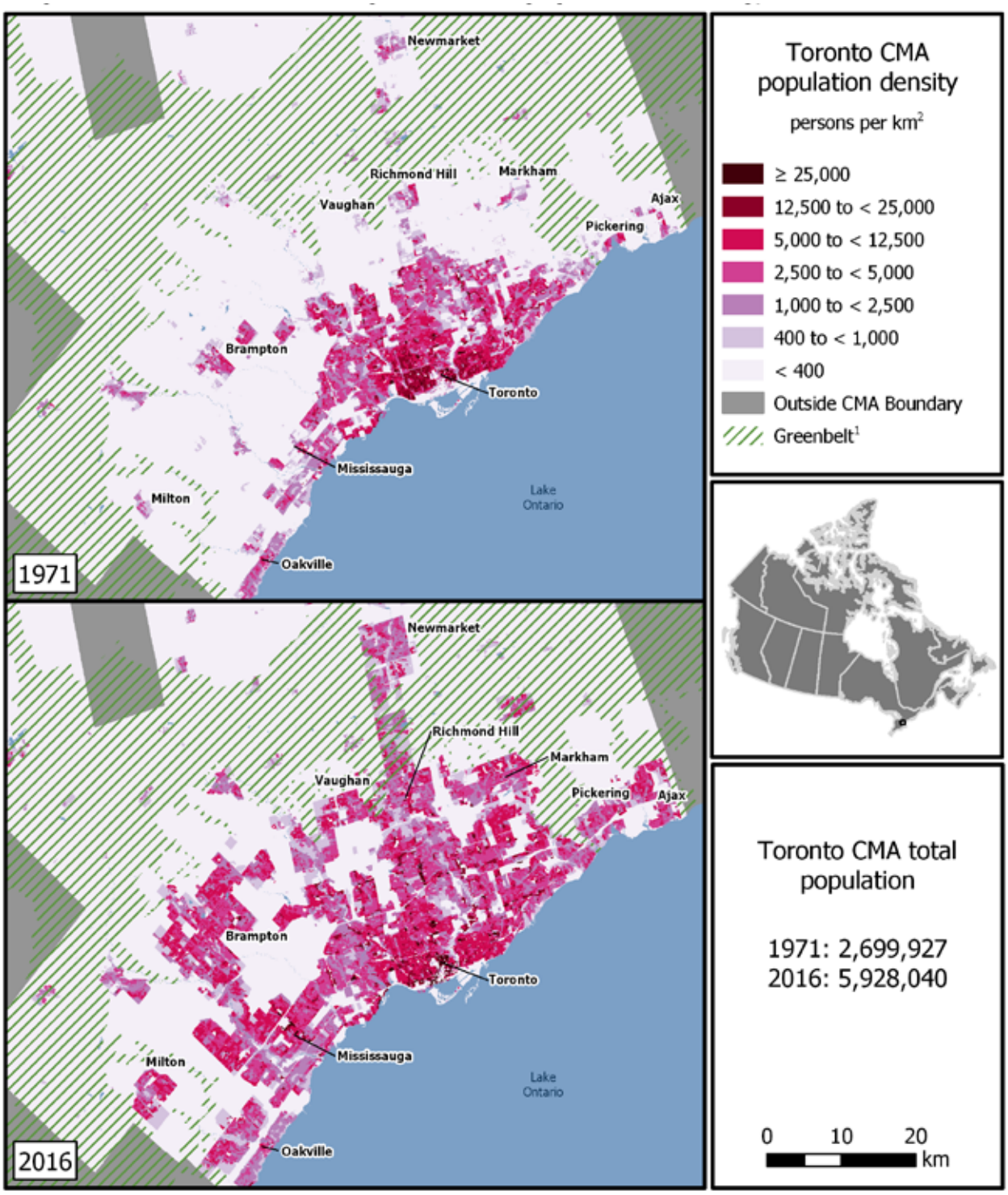


Figure 4.10. Population density and urban growth in the Toronto Census Metropolitan Area, 1971 and 2016.

Source: Statistics Canada, Long-term population density change in Toronto and Vancouver, 1971 to 2016 by Jennie Wang and Hugo Larocque (2019).

Despite a recent focus in Ontario on planning for compact, transit-oriented growth, most residential development continues to be in the form of low-density auto-dependent sprawl on the urban edge. From 1996 to 2016, suburban areas in Ontario grew by 2.4 million residents, compared to growth of less than 0.5 million in urban areas.[12] In the Greater Toronto and Hamilton Area (GTHA), where much of the province's recent growth has occurred, 86% of net growth from 2001 to 2011 was in new greenfield communities, with only 14% in existing urban areas.[13]

At the same time as newer suburbs are growing, many older neighbourhoods in downtowns and inner suburbs are experiencing stagnant or declining population densities. There are now an estimated five million empty bedrooms in the Greater Golden Horseshoe region.[14] This loss of density undermines transit, retail and public services (e.g., schools have closed in 48% of Toronto neighbourhoods as the number and size of families shrink).[15] There is ample room to add family-friendly density (both residents and jobs) back to these areas without expensive new infrastructure. This would revitalize these areas, with benefits both for existing residents and for those looking for new homes.

There is ample room to add family-friendly density back to existing urban areas without expensive new infrastructure.

Family-friendly mid-rise development on Mississauga's waterfront trail.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

The hidden costs of sprawl

Low-density development is more expensive to service compared to more compact areas. The upfront costs of water pipes, sewage systems and roads increase with distance, so the more spread out a development is the higher these costs. They are also more expensive to maintain over their lifetime (Figure 4.11), forcing municipalities to go into debt, raise taxes or continue growing to cover these costs. For example, fast-growing York Region has struggled to pay for sewage and other infrastructure to support its growth, and has the highest per capita municipal debt in the province.

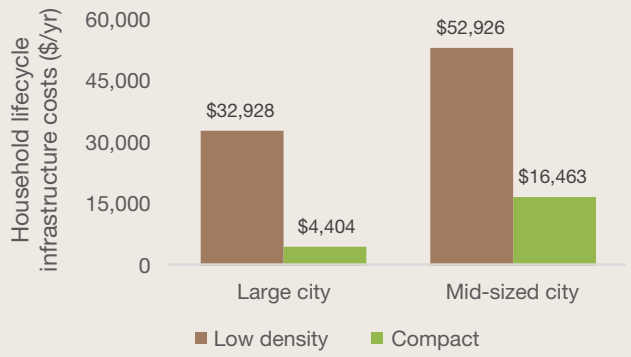


Figure 4.11. Lifecycle infrastructure costs in low-density communities are three to seven times as high as costs in compact communities.

Source: Canada Mortgage and Housing Corporation, Lifecycle Costing Tool for Community Infrastructure Planning Tool: Pilot Findings (2014).

Residents of low-density suburbs can end up paying more than they expected. Partly because low-density suburbs are so expensive to service, municipal property taxes in the GTA are higher in low-density suburbs and lower in higher-density cities.

Personal transportation costs can also end up offsetting the more affordable housing prices in the suburbs. According to the Canada Mortgage and Housing Corporation, residents in many GTA suburbs pay more for housing and transportation than people who live in Toronto and walk or take transit, and can spend up to one extra day per week commuting.[16] Low-income households in the suburbs spend a higher proportion of their income on housing and transportation.[17]

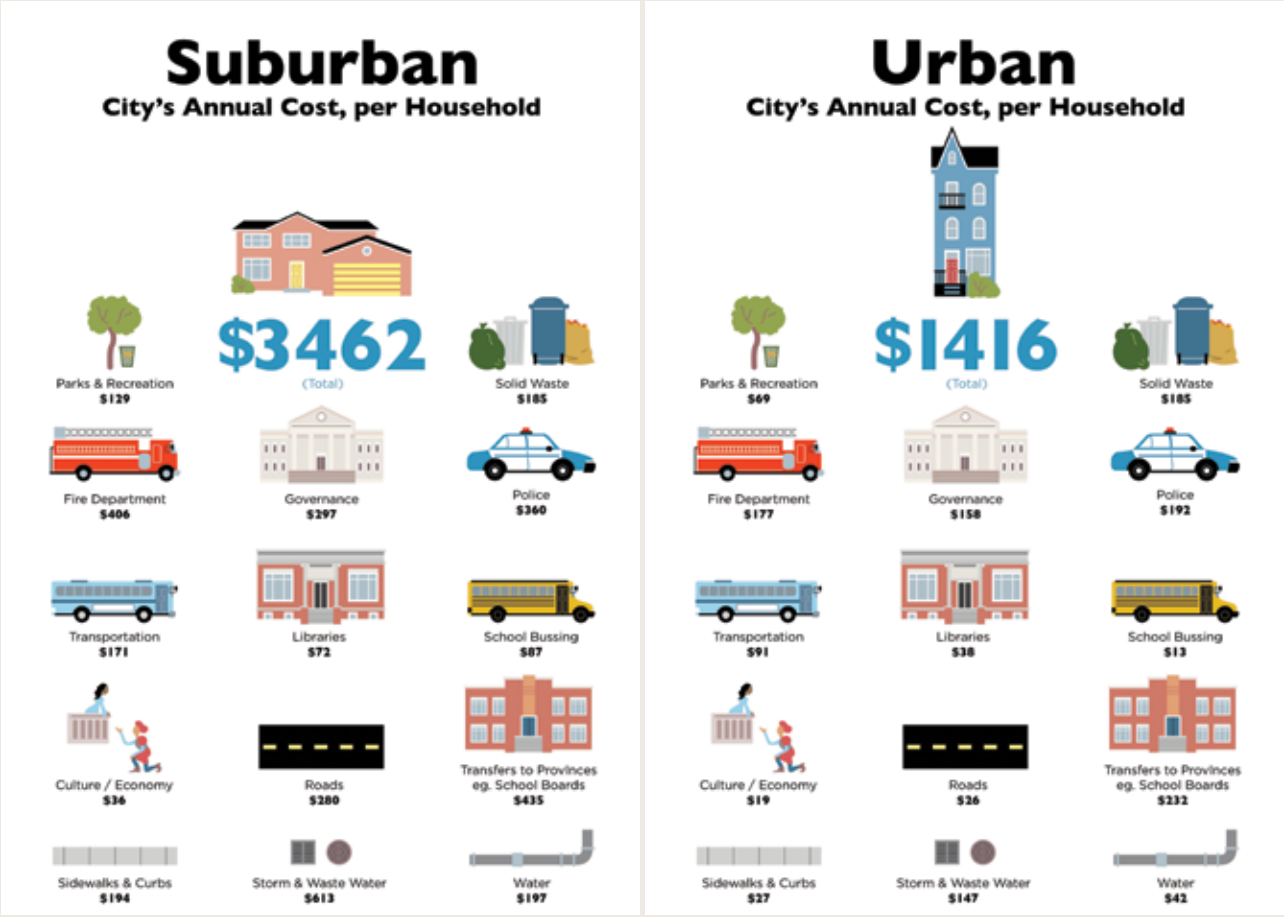
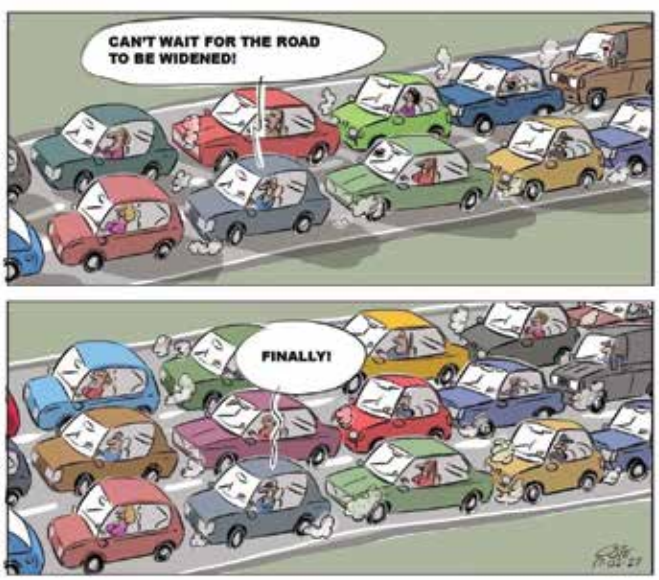


Figure 4.12. Lower densities and larger distances result in higher per household infrastructure and service costs in the suburbs than in urban areas. This example is from Halifax, N.S. but a similar pattern is common in Ontario.

Source: Smart Prosperity Institute, Suburban Sprawl: Exposing Hidden Costs, Identifying Innovations (2013).

4.2.4 To reduce driving, where and how we build housing is important

Experience and extensive research demonstrates that we cannot build our way out of the problems created by low-density sprawl and congested highways. Sprawl begets sprawl, and highways beget congestion. Instead, government planning and transportation decisions must aim to prioritize accessibility – people's access to jobs, goods and services – over the current focus on mobility.



It is now widely accepted that building or expanding roads does little to alleviate traffic congestion.

Credit: André-Phillippe Côté.

Figure 4.13. Decisions about how and where cities grow have significant impacts on energy use and greenhouse gas emissions. The graphic compares two cities – Atlanta and Barcelona – with similar populations but very different urban forms, transportation systems, and per capita emissions.

Source: Adapted from Global Commission on the Economy and Climate, Better growth, better climate: The new climate economy report (2014).

We cannot build our way out of the problems created by low-density sprawl.

Accessible neighbourhoods have a range of transport options (often referred to as "multimodal communities"), a diversity of housing types (including detached, missing middle, mid- and high-rise buildings, including affordable and rental options), and support a mix of different uses so that people can live, work and play in one community. This allows residents to avoid car travel (e.g., by walking to local stores, schools or libraries) or shift to more energy-efficient modes (e.g., by taking public transit instead of driving).

Recent encouraging trends in Ontario show the rate of urban sprawl is slowing, urban core areas are adding population faster than suburban areas, and new developments are being built at higher densities and with a greater mix of housing.[18] Prospective homebuyers are increasingly looking to live in areas with high Walk Scores or close to transit, to avoid lengthy commutes (driving up property values in these locations). Better and more co-ordinated planning can meet the demand for walkable, transit-friendly communities, where people have the option not to drive.

Building the missing middle

Housing choice in the Greater Golden Horseshoe region is largely limited to high-rise condos or single-detached suburban housing – what has been called "tall or sprawl". There is a "missing middle" in the housing market; low- and medium-density dwellings – duplexes, townhouses, walk-up apartments, and second or laneway units – that can accommodate more people in existing neighbourhoods (Figure 4.14). These can provide more affordable family-friendly housing close to transit, adding density without changing neighbourhood character.

An example of missing middle housing: stacked townhouses in Kitchener.

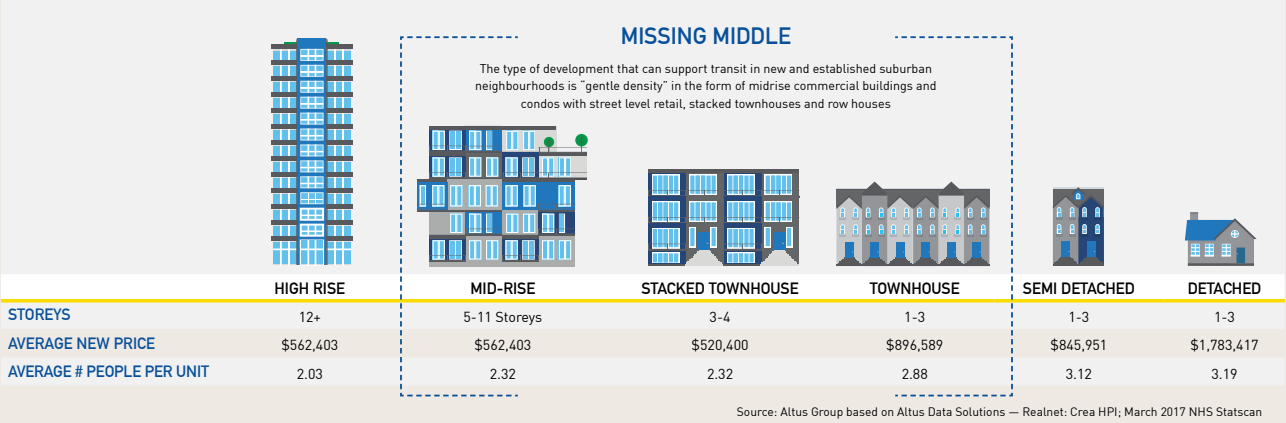
Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

There is a "missing middle" in the housing market.

There is large untapped potential to build the missing middle in existing cities and towns. A 2018 study found that Mississauga could build 174,000 such units on vacant or under-utilized land around GO stations, transit corridors, and growth nodes. This would accommodate 435,000 new residents – 85% of Peel Region's forecast growth to 2041 – without towers or new greenfield development. Around half of these new residents would be within walking distance to transit, reducing the need to drive.[19] The City of Mississauga is currently undertaking its own intensification study to further explore this potential.

Local zoning bylaws and Official Plan policies can prevent missing middle housing from being built. For example, about 75% of the City of Toronto is zoned for residential uses that prevent multi-unit buildings.[20] Any new development in these residential areas must conform to the "existing physical character" of the neighbourhood, which often means single-detached homes. The fees and time involved in trying to rezone a lot are often prohibitive for property owners. This area is known

as the “yellowbelt” for its colour on land use maps. In effect, the yellowbelt forces all new development into a small area, including growth centres, transit stations, and avenues. Some of these are facing limits to infrastructure capacity, while many yellowbelt neighbourhoods are losing population, affecting local schools and other services.



	HIGH RISE	MID-RISE	STACKED TOWNHOUSE	TOWNHOUSE	SEMI DETACHED	DETACHED
STOREYS	12+	5-11 Storeys	3-4	1-3	1-3	1-3
AVERAGE NEW PRICE	$562,403	$562,403	$520,400	$896,589	$845,951	$1,783,417
AVERAGE # PEOPLE PER UNIT	2.03	2.32	2.32	2.88	3.12	3.19

Source: Altus Group based on Altus Data Solutions — Realnet: Crea HPI; March 2017 NHS Statscan

Figure 4.14. Examples of missing middle housing types.

Source: Ryerson City Building Institute.

Other cities are starting to remove these barriers. Vancouver recently announced a target of 10,000 missing middle units over the next decade and amended its zoning to allow duplexes in single-detached neighbourhoods. Minneapolis took a more sweeping approach; in December 2018 it passed a comprehensive zoning reform plan, allowing small apartments (duplexes or triplexes) across the entire city – effectively tripling the housing capacity of some neighbourhoods.

Although a number of zoning alternatives exist, many municipalities in Ontario have been slow to act (although the City of Toronto recently allowed laneway suites in some residential areas). The province could step in, as it did in 2011 when it amended the Planning Act to require municipalities to allow second units (i.e., “granny flats”). It could also clarify policies in the Growth Plan for the Greater Golden Horseshoe that encourage intensification “through the built-up area” – and enforce these policies during the municipal conformity process. And it should follow through on requirements that municipalities update their zoning bylaws three years after an official plan update.

Finally, the province could ensure that planning and land budgeting studies support the “intensification first” approach of the Plan. As suggested during recent consultations on increasing housing supply,[21] one approach that Ontario could adopt is the U.K.’s Strategic Housing Land Availability Assessment, which explores the development potential and economic feasibility of existing sites, then identifies policy barriers, such as zoning, that can be addressed.

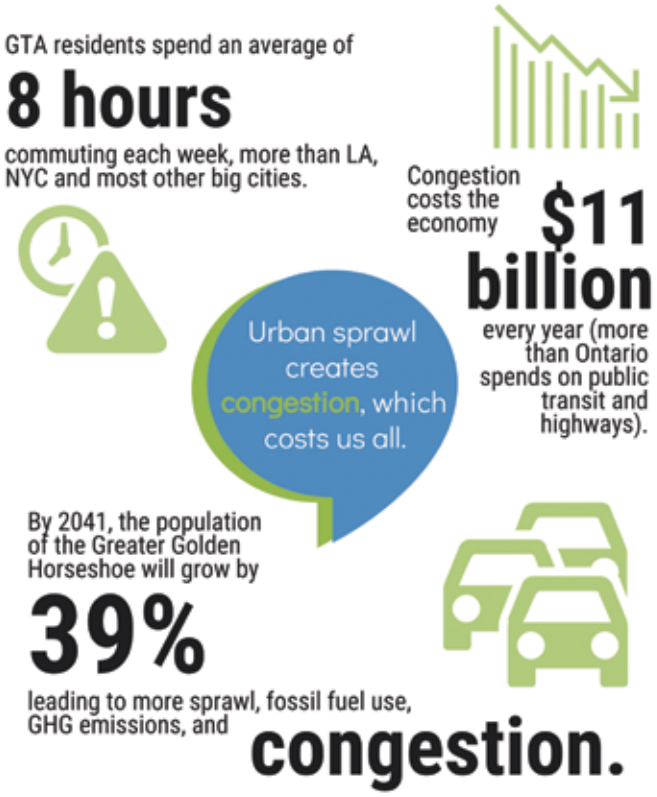


Figure 4.15. Ontario's land use plans are creating urban sprawl, which will increase the already high costs of congestion.

Sources: The Best and Worst Cities for Commuting, Expert Market, 2018; C.D. Howe Institute, Cars, Congestion and Costs (2013)

The provincial Growth Plan is supposed to be the framework for sustainably managing growth.

4.3 Ontario's Growth Plan claims to reduce car use

The provincial Growth Plan for the Greater Golden Horseshoe (hereafter the "Growth Plan") is supposed to be the framework for sustainably managing growth in the fast-growing region around Toronto. By 2041 the Greater Golden Horseshoe (GGH) is forecast to grow by more than 4 million residents and nearly 2 million jobs. How can the region accommodate this growth while avoiding more car travel and congestion, reducing GHG emissions, and preserving prime agricultural land and natural heritage areas?

Unfortunately, the Growth Plan's goals – of a reduction in sprawl and car-dependency, and the creation of multimodal, 'complete' communities – are being undermined by flaws in its design, lack of provincial oversight, and poor implementation. The Growth Plan allocates massive residential growth to outlying, low-density areas (against the province's own growth projections and recent trends) and pays little attention to recent gains and loss in population and employment. Meanwhile, amendments proposed in January 2019 would further loosen restrictions on sprawl.

Below we describe the Growth Plan – why it was created, what it is supposed to do, and how it works – before discussing the problems and highlighting some potential solutions.

4.3.1 What is the Growth Plan?

The Growth Plan was released in 2006 to implement the Places to Grow Act, 2005. The Growth Plan aims to provide a long-term framework to manage growth in the GGH region, which is home to 68% of Ontarians and generates 25% of Canada's gross domestic product (Figure 4.16). It works in parallel with the Greenbelt, Niagara Escarpment and Oak Ridges Moraine Conservation Plans, which identify natural and agricultural areas where growth is limited or prohibited.

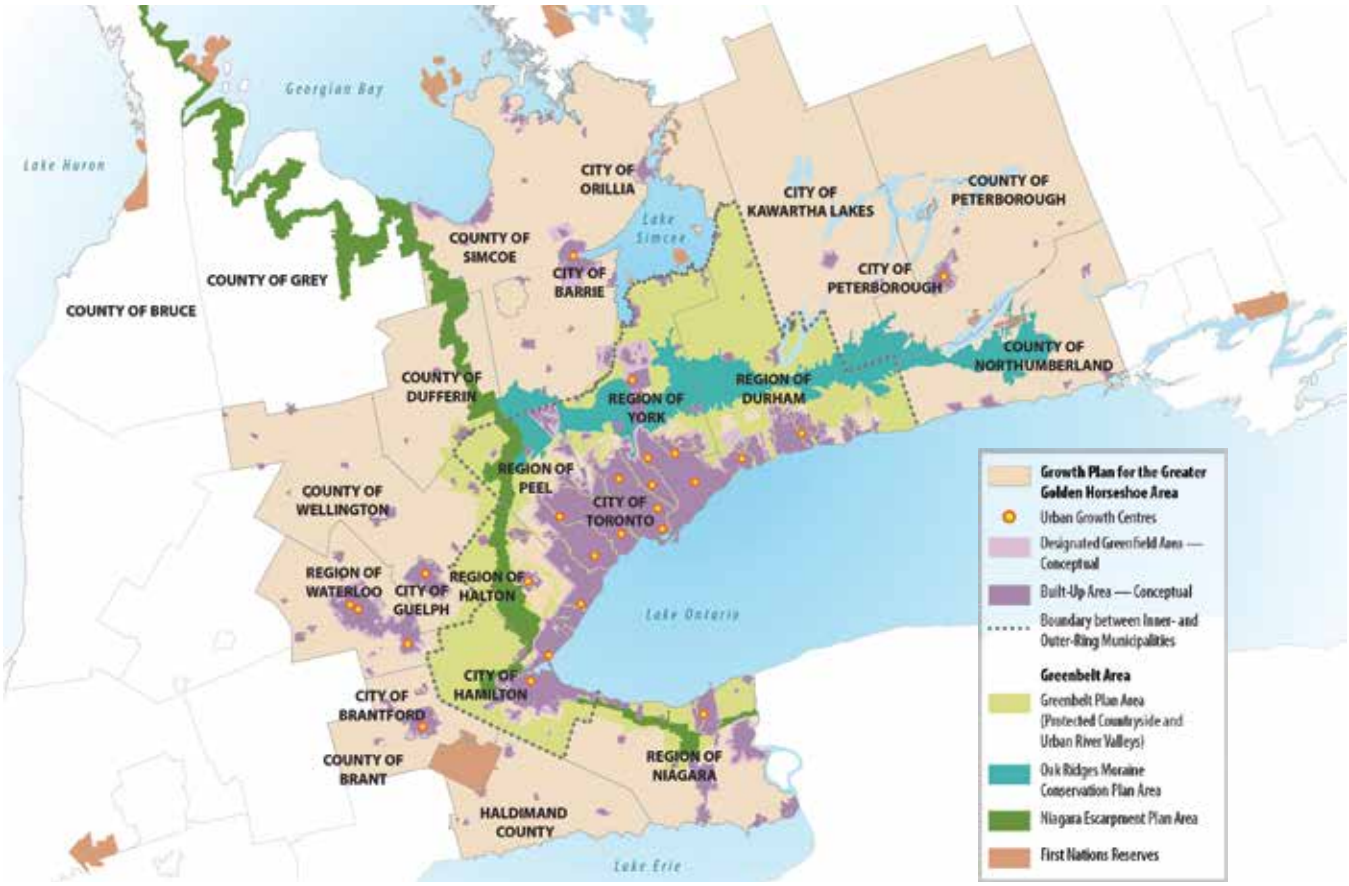


Figure 4.16. The Greater Golden Horseshoe region, showing the Inner Ring and Outer Ring municipalities.

Source: Ministry of Municipal Affairs and Housing.

The Growth Plan was intended to dramatically slow urban sprawl, but has largely failed to do so.

The Growth Plan was created because of rapid regional growth (more than 100,000 people per year) occurring in the form of expensive urban sprawl. The GGH urban area more than doubled between 1971 and 2006. This growth, much of it low-density, car-dependent suburbs, was built over the region's natural heritage and its prime farmland, which is among the most productive in the country. It also led to traffic congestion, growing commute times, and air pollution. The Growth Plan was intended to dramatically slow urban sprawl, but has largely failed to do so. See sections 4.3.3 to 4.3.5 for details.

In 2017, after a two-year coordinated review including extensive public and stakeholder consultation, the Growth Plan was updated to strengthen a number of policies and add new sections (e.g., on climate change). The 2017 amendments had the potential to make the Growth Plan stronger and more effective. In January 2019, the provincial government proposed Amendment 1 to the 2017 Growth Plan. If adopted, this would roll back some of the 2017 changes in response to concerns expressed by the development industry and some municipalities. See section 4.4 for details.

Figure 4.17. A timeline of the Growth Plan for the Greater Golden Horseshoe.

Source: Environmental Commissioner of Ontario.

4.3.2 How does the Growth Plan work?

The province forecasts the amount of residential and job growth it expects in the region. By 2041, it expects about 13.5 million residents (up from 9.7 million in 2016) and 6.3 million jobs (up from 4.8 million). Through the Growth Plan, it allocates this forecast growth to single- and upper-tier municipalities. Upper-tier municipalities, in turn, distribute their allocations among their lower-tier municipalities.[22]

These Growth Plan allocations are critical because they set the long-term trajectory for the GGH region – how much and where growth is happening. They dictate local planning decisions, because municipalities must develop Official Plans that will accommodate their assigned growth.

Growth Plan allocations dictate local planning decisions, because municipalities must accommodate their assigned growth.

The Growth Plan claims to direct the "majority of growth" to existing settlement areas, with a focus on urban growth centres, major transit station areas, and other "strategic growth areas" (see Section 2.1 of the Growth Plan). The Growth Plan also includes other policies that control or affect municipal land use decisions (Figure 4.18). These include minimum targets for intensification and greenfield area densities (Table 4.2), which determine how much growth should be in existing urban areas with services and infrastructure; and how much (and at what density) is in the form of new communities on the urban edge. The Growth Plan includes a number of other policies that claim to support more compact communities, encourage transit and active transportation, help municipalities plan for infrastructure to support growth, and protect water, farmland, natural heritage, and other natural resources.

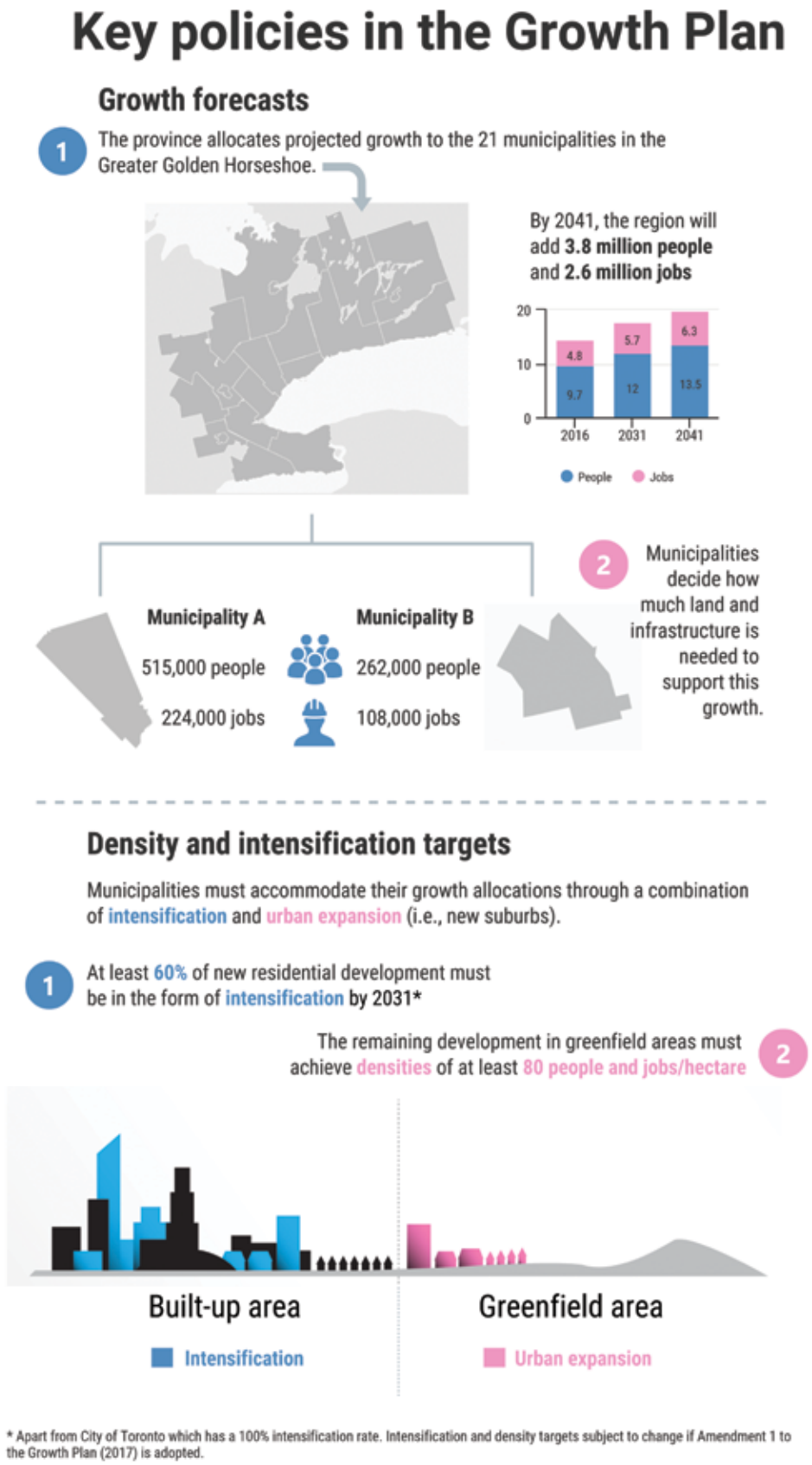


Figure 4.18. The main policy levers of the Growth Plan: growth forecasts, intensification and density targets.

Source: Environmental Commissioner of Ontario.

Although municipalities are responsible for implementing the Growth Plan through their Official Plans and other planning tools (e.g., zoning bylaws, site plans, permits etc.), the province plays an important role in oversight, approvals, and performance monitoring. Upper- and single-tier municipalities undertake a municipal comprehensive review to ensure their Official Plans conform with the Growth Plan. This includes budgeting how much land is needed to accommodate growth (through a Land Needs Assessment), setting local targets, and directing growth to lower-tier municipalities. This process can take several years; the deadline for conforming to the most recent Growth Plan (2017) is July 2022, although appeals and delays may delay conformity beyond this date.

Ontario's land use planning framework

Ontario's land use policies claim to manage urban growth efficiently and sustainably, by increasing densities, encouraging development in existing urban areas and close to transit, reducing urban sprawl, and supporting the creation of complete communities. Land use planning in Ontario is governed by the Planning Act 1990, which sets ground rules for how land uses are controlled and who is responsible for what. The province sets high level policy direction through the Provincial Policy Statement (PPS) and provincial plans (e.g., Growth Plan, Greenbelt Plan). Municipalities must ensure local planning decisions and plans are consistent with provincial policies; they do this through Official Plans, zoning bylaws, transportation master plans, and other tools.

Recent amendments to the Planning Act include "mitigation of greenhouse gas emissions and adaptation to a changing climate"[23] as matters of provincial interest, which means all planning decisions must take climate change into account. Municipalities must also develop local planning policies to mitigate and adapt to climate change. The PPS provides specific policies to support efficient use of land and compact urban form, promote energy conservation and efficiency, and promote urban growth that supports transit and active transportation.

Figure 4.19. A schematic showing the land use planning framework in Ontario, from provincial (top) to local (bottom).

Source: Ontario Ministry of the Environment, Conservation and Parks, Community Emissions Reduction Planning: A Guide for Municipalities (2017) at 27.

Table 4.2. Key Growth Plan policies that can reduce car travel and sprawl.

Policy	Details	Impact on Vehicle Kilometres Travelled
Intensification targets (2.2.2)	60% of residential development must be within built-up areas (until 2031, the target is 50%)	Locating more housing in existing urban areas reduces the need for lengthy commutes and creates more density to support transit alternatives
Greenfield density targets (2.2.7)	Designated greenfield areas must be planned for densities of at least 80 residents and jobs / ha, and support transit and active transportation	New communities should be planned to reduce reliance on cars and provide viable alternatives. Ministry of Transportation transit supportive guidelines suggest at least 80 residents and jobs/ha is needed to support frequent bus service (every 10-15 minutes)
Transit-supportive densities (2.2.4)	Major transit station areas must achieve densities of at least 150-200 residents and jobs / ha (depending on type of transit), support an affordable, diverse housing mix, and provide infrastructure for cycling and walking	Densities of at least 160 residents and jobs/ha are required to support dedicated rapid transit and 200/ha for subways. Providing more affordable housing and active transportation options allows people to live close to, or travel to, transit stations without relying on a car
Transportation demand reduction (3.2.2)	Requirements for municipalities and office parks to develop transportation demand reduction plans to reduce reliance on single-occupancy vehicles and prioritize transit and active transportation.	Transportation Demand Management policies support employers and employees to reduce the need or distance travelled by cars, and choose more efficient options, e.g., carpooling, transit, etc.
General transportation policies (3.2.2 / 3.2.3)	The GGH transportation system must offer a balance of choices, reduce reliance on cars, and provide multimodal access to jobs, housing, schools and other amenities Public transit will be the first priority for transportation infrastructure planning All transport planning and investment decisions will support increasing transit mode share and reducing GHG emissions	Policies provide direction to municipalities to plan for more efficient transportation systems and reduce reliance on cars
Climate change policies (4.2.10)	Municipalities will develop strategies and policies to reduce GHG emissions and address climate change to, including reducing dependence on cars and supporting alternatives	Providing low-carbon alternatives to cars can help reduce GHG emissions

Note: Policies refer to 2017 Growth Plan. Intensification and greenfield density targets may change subject to the approval of Amendment 1 (proposed in January 2019). The proposed Amendment is discussed in more detail below.

4.3.3 Growth Plan performance (2006-2018)

What has the Growth Plan achieved since its release in 2006 and subsequent update in 2017?

The Growth Plan has not delivered compact, transit-oriented growth.

While claiming to set ambitious targets for compact, transit-oriented development, the Growth Plan has not delivered compact, transit-oriented growth. Many municipalities have continued to grow through low-density suburban sprawl, rather than by intensifying existing urban areas. Despite the Growth Plan's attempts to reign in sprawl, municipalities have set aside at least 1,000 km^2 of farmland and natural areas for future growth to 2031; this is no less than was projected before the Growth Plan's creation.[24]

This type of low-density sprawl is costly (for municipal budgets, through higher infrastructure costs, and for individuals, through higher taxes and transportation costs). Low-density sprawl creates less energy-efficient communities and increases reliance on automobiles – one of Ontario's largest sources of GHG emissions. Finally, sprawl directly affects well-being for many residents, who are forced into lengthy, polluted, congested commutes because they have few alternatives.

This result is partly due to the design of the Growth Plan (see sections 4.3.4 and 4.3.5), and partly due to poor implementation and policy exemptions allowed by the province. There are some caveats.

First, measuring planning outcomes is challenging. Most important is the time lag between planning decisions and development or transportation outcomes. These can take years or decades to reach fruition (due to lengthy planning approval processes), so that much of the development currently being seen across the GGH may have been planned before the Growth Plan's policies came into effect.

A mixed-use development in downtown Oakville.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

Second, there have been lengthy delays in the implementation of the Growth Plan policies because of appeals to the Ontario Municipal Board (now the Local Planning Appeals Tribunal). As late as 2015 (nine years after the release of the Growth Plan), 13 upper/single-tier municipalities had still not updated their Official Plans to conform with it.[25] (According to the Ministry of Municipal Affairs and Housing, as of January 2017 all single- and upper-tier municipalities were in conformity).[26] The deadline for conformity with the 2017 Growth Plan is 2022, but it remains to be seen whether municipalities will be ready for that under the new Local Planning Appeals Tribunal appeals process.

Recognizing that there are delays and time lags that can affect implementation, how well has the Growth Plan performed?

The province's assertions that growth is meeting intensification and density targets are not backed up by data.

4

The province claims that growth governed by the Growth Plan is meeting intensification and density targets. For example, in its 2015 Performance Indicators[27] the province states:

- "many municipalities are achieving or exceeding their required intensification target ahead of the 2015 target date", with an average regional intensification rate of 60% (44% excluding Toronto), and
- "planned densities [for designated greenfield areas] meet the targets in the Growth Plan", and estimated densities for new greenfield developments in the Inner Ring were 51 people and jobs per hectare.

However, these assertions are not backed up by the data. The reported intensification rates were from 2007-2010 (before most municipalities had updated their Official Plans to conform with the Growth Plan) and apply to development within the "built boundary". This area includes development that should not be counted as "intensification", such as thousands of vacant greenfield lots in subdivisions on the urban edge that were still building out at the time the built boundary was defined (e.g., over 3,000 such vacant lots were included in the built boundary in Waterloo Region),[28] or development in so-called "undelineated" built-up areas, i.e., rural areas on privately-serviced subdivisions. A later study reported that subsequent intensification rates in many municipalities (e.g., the Regions of Niagara, Peel and Durham, and City of Hamilton) were up to 37% lower, likely reflecting a more accurate figure once surplus land was developed.[29]

Similarly, the province's claim (in its 2015 Performance Indicators report) that planned greenfield densities are meeting Growth Plan targets is misleading, given that nine municipalities (nearly half the total) were granted "alternative" lower targets than the minimums set out in the Growth Plan itself. As well, the province's figures for new greenfield development are based on small sampling sizes; e.g., just 2.6% of Halton Region's and 3.1% of Durham Region's designated greenfield areas were analyzed.[30] They also likely reflect development approved before the 2006 Growth Plan came into effect.

Accurate and regular performance monitoring is important as it helps the province, stakeholders and the public better understand what progress the Growth Plan is making towards its regional and local goals. It can also point to areas where improvements or extra attention are required. For example, the claim that urban growth centres are "making progress towards their targets"[31] is true to an extent (several are already exceeding target densities), but ignores the fact that others face serious challenges (e.g., with a lack of supporting transit or water/wastewater infrastructure) and others are seeing little or no growth in employment (a critical component of attempts to create "complete communities" and reduce the need for lengthy commutes). Similarly, if greenfield densities or intensification rates are not as high as claimed, more attention must be paid on addressing barriers to implementation, instead of simply raising targets to levels that may be unachievable.

Mississauga City Centre transit station.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

Greater attention is also needed to the challenge of creating higher densities around transit stations. The Growth Plan sets transit-supportive density targets, based on Ministry of Transportation guidelines, to focus residential and employment growth around "major transit station areas". Few of the 333 identified major transit station areas were meeting these targets in 2011 (Figure 4.20). In fact, 43% of these areas (including 78% of GO train stations) did not have enough density nearby to support any kind of transit.[32] Municipalities and the province have struggled to increase densities around these areas, with just 18% of recent residential growth occurring within walking distance of frequent transit.[33]

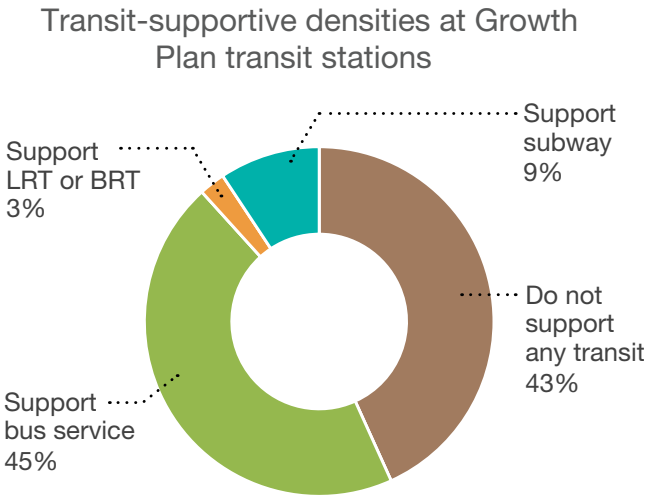


Figure 4.20. Out of 333 existing and planned major transit station areas in the Growth Plan, only 39 (12%) have sufficient densities to support dedicated transit service (i.e., subway, GO train, light rail transit (LRT) or bus rapid transit (BRT)), while 144 (43%) do not have sufficient densities to support any viable transit service.

Source: Ontario Ministry of Municipal Affairs and Housing, Performance Indicators for the Growth Plan for the Greater Golden Horseshoe, 2006 (Toronto: MMAH, 2015).

Despite its ambitious policies, the Growth Plan has not been properly implemented, with the province largely abdicating its oversight role in favour of delegating decisions to upper- and single-tier municipalities. The result is a patchwork of local targets and mixed progress, with some municipalities moving towards compact, transit-supportive growth while others continue to sprawl. A 2004 Ontario government discussion paper projected that business-as-usual growth would pave over 1,000 square km of land by 2031, "jeopardiz[ing] the financial, social and environmental factors that make the region so attractive to new residents and new economic growth."[34] In fact, under the Growth Plan the amount of land budgeted for growth to 2031 is even higher at 1,071 square km. This is now locked into municipal official plans and will be challenging to reverse.[35]

The Growth Plan has not been properly implemented.

The 10-Year Coordinated Land Use Planning Review (2015-2017) offered some hope that this trajectory might be changing. The review led to a number of recommendations to strengthen the Growth Plan, including higher targets, a greater emphasis on integrated planning and climate change, and more oversight and accountability.[36] Many of these were adopted in the 2017 update to the Growth Plan, although there were still concerns about a lack of oversight and accountability for the plan's implementation.

However, the Growth Plan continues to actively direct sprawl; see section 4.3.4. As well, the proposed Amendment 1 announced in January 2019 risks undoing much of the progress made over the past three years to strengthen the Plan.[37] For more details on Amendment 1, see section 4.4.

Mount Pleasant Village in Brampton – an example of a mixed-use community built around transit.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

Car travel in the Greater Golden Horseshoe

In 2016, 77% of trips in the GGH were by car.[38] This is slightly less than 2011 (80% of trips by car), but overall there has been little change in mode share since 1996. The number of trips by car has grown from about 10.5 million in 1996, to 13.5 million in 2016 (meanwhile, trips by transit, walking, cycling and other modes grew from 2.6 million to 4 million). The fastest growth has been in walking and cycling (up 77%) and local transit (up 46%).

The total amount of car vehicle kilometres travelled (VKT) grew by 26.3% from 2001 to 2016 – but over the same period, per capita VKT actually dropped, from 25.8 km to 24.1 km (a 6.5% decrease). This trend is driven by lower per capita VKT in the more urbanized Inner Ring municipalities, where residents are increasingly using transit and walking or cycling. Younger urban residents across the GGH are also driving less, with driver's licence rates among 16-25 year olds dropping in Toronto (-11%), Peterborough (-10%) and Barrie (-8%) from 1986 to 2011.[39]

However, car travel is not declining in Outer Ring municipalities. As Figure 4.21 shows, car travel in the Outer Ring grew almost five times faster than the Inner Ring since 2001. Per capita daily car travel in the Outer Ring declined from 2001-2011, but began to grow again from 2011-2016 and – at 34.4 km/day – is significantly higher than the Inner Ring.

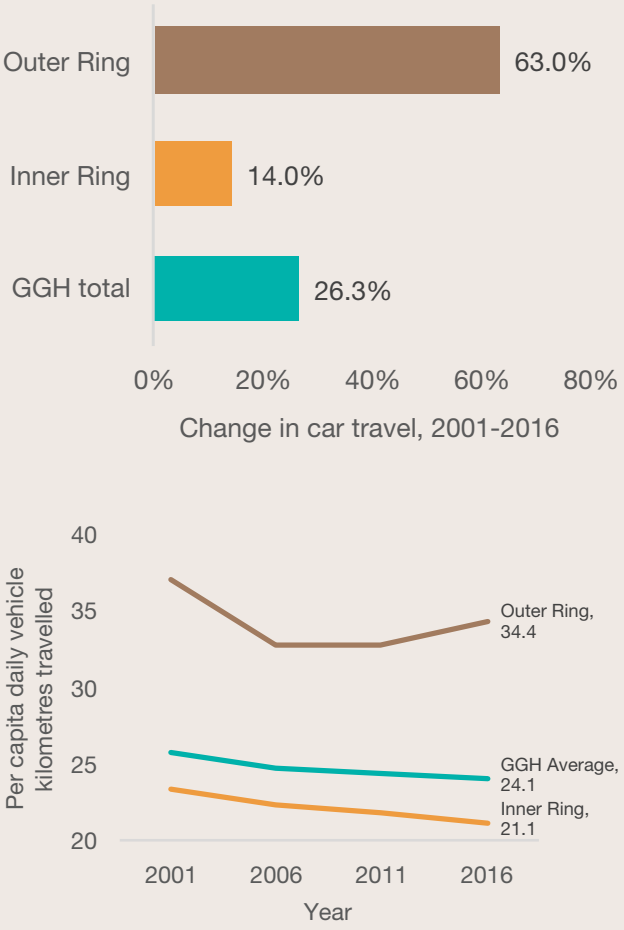


Figure 4.21. Car travel trends in the Greater Golden Horseshoe and its Inner and Outer Rings. Left: Total vehicle-km travelled (VKT) has increased 63% in the Outer Ring between 2001 and 2016, faster than the Inner Ring. Right: Per capita daily VKT has dropped across the GGH from 2001 to 2016, but is significantly higher in the Outer Ring, where it has increased since 2006.

Source: Transportation Tomorrow Survey, University of Toronto Transportation Research Institute (2016).

4.3.4 Growth Plan population allocations increase sprawl

The population and employment allocations in the Growth Plan (schedule 3) drive municipal land-use planning, as municipalities are required to accommodate the allocated levels of growth. The Growth Plan calls these allocations "forecasts", but they have legal force with significant impact on long-range municipal planning, land budgets and infrastructure spending.

According to these allocations, by 2041 the GGH is expected to reach nearly 13.5 million residents and 6.3 million jobs (see Table 4.3 for sub-regional split). This is similar to the Ministry of Finance (MOF) forecast for the GGH region (about 13.3 million).[40] However, the MOF forecast and the Growth Plan allocations differ substantially in how growth is to occur at a sub-regional level (Inner Ring versus Outer Ring) and between municipalities. These differences have become so large in some cases that they have been called "a threat to efforts to control sprawl."[41]

Table 4.3. Distribution of population and employment in the Inner and Outer Rings of the GGH in 2031 and 2041.

	Population (000s) and % change from 2016		Employment (000s) and % change from 2016	
	2031	**2041**	**2031**	**2041**
Inner Ring (GTHA)	9,010 (+23%)	10,131 (+38%)	4,380 (+17%)	4,820 (+29%)
Outer Ring	2,940 (+26%)	3,350 (+43%)	1,280 (+20%)	1,450 (+35%)
GGH Total	**11,950 (+23%)**	**13,480 (+39%)**	**5,650 (+18%)**	**6,270 (+30%)**

Source: Growth Plan for the GGH (2017), Schedule 3 and Hemson Consulting Ltd., Greater Golden Horseshoe Growth Forecasts to 2041 (2013) at 62.

The Growth Plan allocations do not accurately reflect either the MOF forecasts or the actual amount of growth happening across the region. The MOF projections extrapolate future population growth based on recent trends in demographics, immigration and migration. They are updated annually to take into account shifts in these trends. They also include high, medium and low projections to account for longer-term uncertainties. In contrast, the Growth Plan allocations redistribute this projected growth based on policy assumptions and priorities (which are not explicitly stated). The allocations were last updated in 2013, and set out a single, fixed allocation to 2041 (rather than a range of scenarios).

The Growth Plan directs municipalities to create much more urban sprawl than the MOF projects would happen without the Growth Plan.

Growth Plan directs more growth to Inner Ring, less to Outer Ring

From 2016 to 2041, the Growth Plan allocates growth of 2.78 million to the Inner Ring and 0.99 million to the Outer Ring. The Spring 2018 MOF projection of growth over the same period is 3.11 million to the Inner Ring, and 0.66 million to the Outer Ring. In other words, the Growth Plan directs homes for about 330,000 people away from the Inner Ring (close to employment centres and frequent transit lines) to the less urbanized Outer Ring communities (Figure 4.22).

For Outer Ring municipalities, the MOF projections represent a shortfall of 34% compared to the forecasts in the Growth Plan. This shortfall represents potential lost development charges that municipalities would depend on to pay for infrastructure to support growth. It also represents the over-allocation of land that municipalities will budget for anticipated growth that, if the MOF is correct, will never materialize.

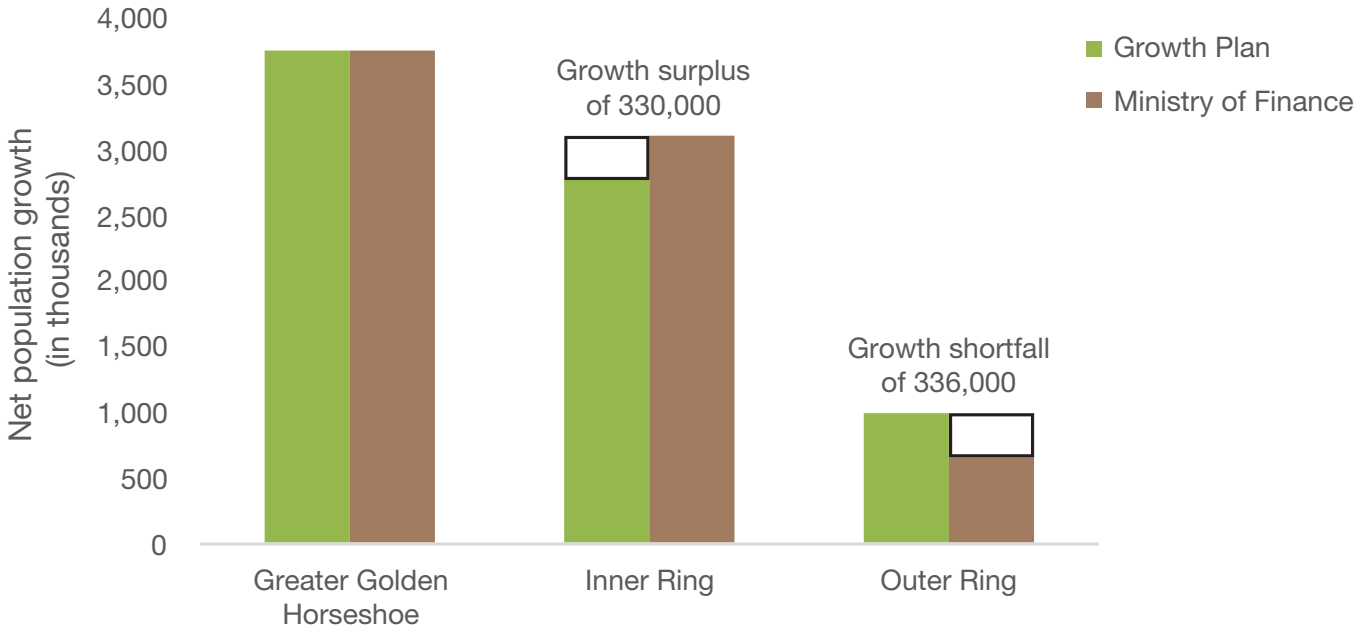


Figure 4.22. Comparison of projected growth for 2016-2041 in the Greater Golden Horseshoe from the Ministry of Finance (MOF) and Growth Plan. The MOF projects a growth surplus in the inner ring and shortfall in the outer ring compared to the Growth Plan.

Sources: Ontario Ministry of Finance, Ontario Population Projections Update, 2017-2041, Table 4; Ontario Ministry of Municipal Affairs and Housing, Growth Plan for the GGH (2017), Schedule 3.

The Ministry of Finance projects large growth shortfalls for most municipalities

These growth differences are very large for some municipalities (Figure 4.23). For example, over the 2016-2041 period, the MOF projects 507,000 more people in the City of Toronto – almost double the number in the Growth Plan forecast. Similarly, for Peel Region the MOF projects 46% more growth (234,000 people) than the Growth Plan. By contrast, the MOF projects 237,000 fewer people in Durham Region (a shortfall of 47%); 95,000 (36%) fewer in Waterloo Region; 92,000 (31%) in Simcoe County (including Barrie and Orillia); and 86,000 (20%) fewer in Halton Region. For 15 out of 21 municipalities in the GGH, the MOF projects a growth shortfall of more than 20%. This could have major implications for municipal finances, as municipalities depend on revenues from anticipated growth (e.g., development charges and property taxes) to fund improvements to infrastructure and local services.

The Growth Plan directs municipalities to create more urban sprawl than the Ministry of Finance projects would happen without the Growth Plan.

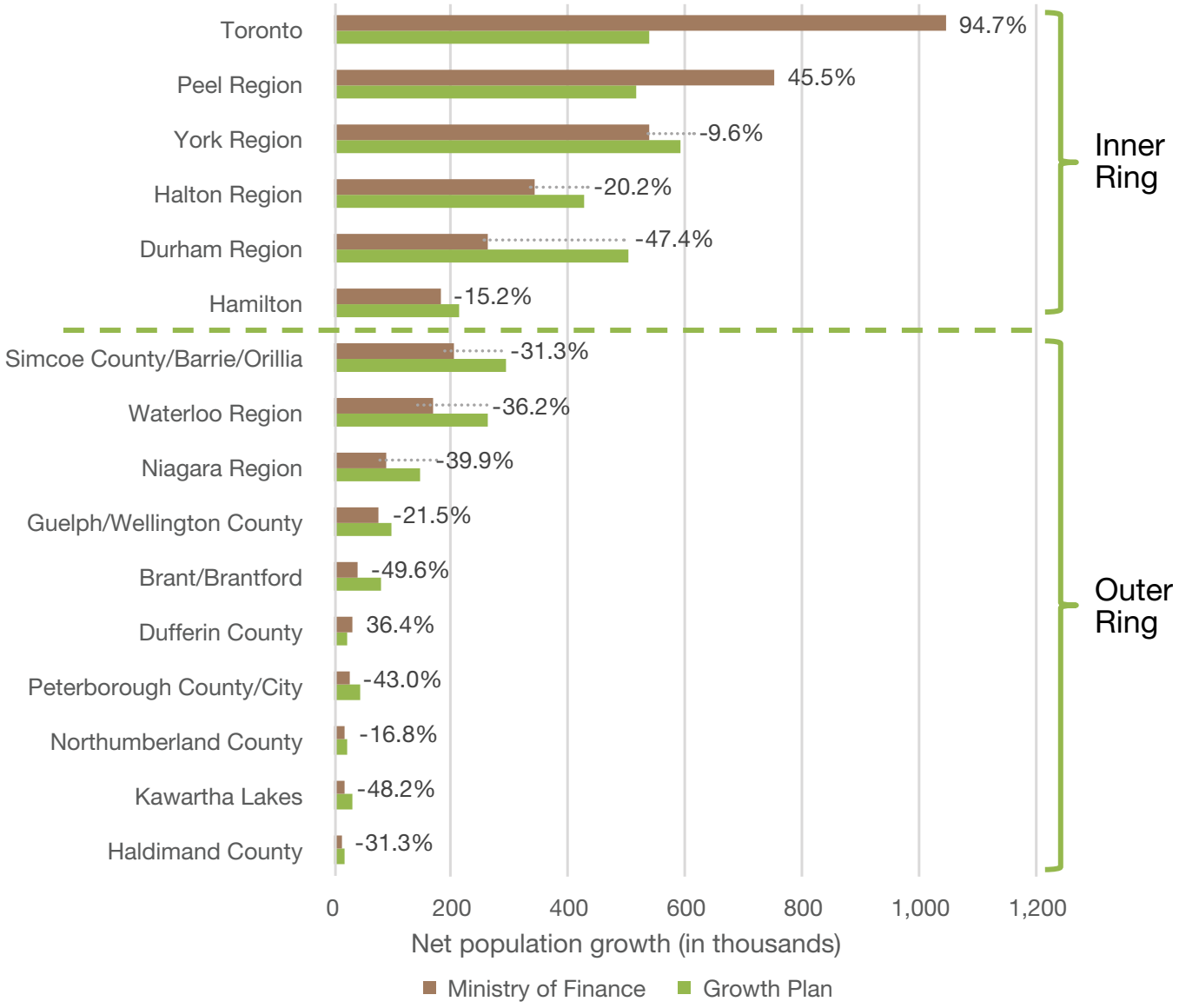


Figure 4.23. Comparing 2016-2041 growth projections from the Ministry of Finance and Growth Plan for municipalities in the Greater Golden Horseshoe. The MOF expects most municipalities to see less growth than the Growth Plan instructs them to prepare for, with only Toronto, Peel Region and Dufferin County to grow more than the Growth Plan calls for.

Sources: Ontario Ministry of Finance, Ontario Population Projections Update, 2017-2041, Table 4; Ontario Ministry of Municipal Affairs and Housing, Growth Plan for the GGH (2017), Schedule 3. Note: some single-tier municipalities have been merged to allow for comparison between projections.

Table 4.4. A comparison of projected population growth (2016-2041) between the Growth Plan and Ministry of Finance, showing the large discrepancies for some municipalities.

Municipality	Projected population growth, 000s (2016 to 2041)		Difference	
	Growth Plan	Ministry of Finance	Absolute	Percentage
Region of Durham	499	262	-237	-47.4%
Region of York	591	534	-57	-9.6%
City of Toronto	535	1,041	507	94.7%
Region of Peel	515	749	234	45.5%
Region of Halton	425	339	-86	-20.2%
City of Hamilton	212	180	-32	-15.2%
INNER RING TOTAL	**2,777**	**3,107**	**330**	**11.9%**
County of Northumberland	22	18	-4	-16.8%
County and City of Peterborough*	44	25	-19	-43.0%
City of Kawartha Lakes	28	15	-14	-48.2%
County of Simcoe, Cities of Barrie and Orillia*	293	201	-92	-31.3%
County of Dufferin	22	30	8	36.4%
County of Wellington, City of Guelph*	97	76	-21	-21.5%
Region of Waterloo	262	167	-95	-36.2%
County of Brant and City of Brantford*	77	39	-38	-49.6%
Region of Niagara	147	88	-59	-39.9%
OUTER RING TOTAL	**995**	**660**	**-336**	**-33.7%**
GGH TOTAL	**3,771**	**3,766**	**-5**	**-0.1%**

Note: Outer Ring municipalities marked with * have been merged to allow for comparison between MOF projections (which are for Census Divisions) and Growth Plan forecasts (which are for upper- and single-tier municipalities). The County of Haldimand has been excluded from Outer Ring and GGH totals, as the MOF projection is for the Census Division of Haldimand-Norfolk only and is not directly comparable to the Growth Plan forecast. This exclusion has little effect on the regional differences, as Haldimand's growth of 16,000 represents 0.4% of GGH growth to 2041. Numbers rounded to nearest 10,000 for Inner Ring municipalities and Inner/Outer Ring totals, and nearest 1,000 for Outer Ring municipalities. Total may not add up due to rounding.

Sources: Ministry of Municipal Affairs and Housing, Growth Plan for the Greater Golden Horseshoe (2017), Schedules 3 and 7; Hemson Consulting Ltd., Greater Golden Horseshoe Growth Forecasts to 2041, June 2013, Table 1: Distribution of Population and Employment for the Greater Golden Horseshoe - Reference Scenario; Ministry of Finance, Ontario Population Projections Update, 2017-2041 (Spring 2018), Table 4: Historical and projected population by census division, selected years — reference scenario.

Downtown Peterborough.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

Comparing Growth Plan projections to actual growth

How do the Growth Plan's allocations of future growth compare with what has happened already? From 2001 to 2016, about 81% of GGH population growth was in the Inner Ring. For 2016 to 2041, the Growth Plan directs this percentage to decrease to 73%. In other words, the Growth Plan is allocating much faster growth to the Outer Ring (1.73% per year) than is happening now (1.17% per year between 2001 and 2016).

The Growth Plan is allocating much faster growth to the Outer Ring than is happening now.

We can also look back to check how accurate the Growth Plan's forecasts have been. In its 2013 forecast, the Growth Plan projected residential growth of 1.25 million for the GGH as a whole between 2006 and 2016. According to the 2016 Census, the region actually grew by 174,000 fewer people (a 14% discrepancy). Real population growth was 16% less in the Outer Ring and 13% less in the Inner Ring than forecast, again suggesting that the Growth Plan is directing Outer Ring municipalities to prepare for more growth than may occur. This finding is supported by other studies looking at forecast vs real growth.[42]

The Growth Plan's prescriptive demands for low-density growth are not justified by market demand.

What do these discrepancies mean? They suggest that the Growth Plan's prescriptive demands for low-density growth in Outer Ring and/or less urbanized regions (e.g., Durham, Waterloo, Simcoe) over urban centres with existing transit systems and large numbers of jobs (e.g., Toronto, Peel) are not justified by market demand or demographic trends.

When Growth Plan allocations (as adopted by municipal official plans) become development, these mismatches will have serious economic consequences. Existing urban centres may build less housing than is desired, driving up prices in these centres, while less urbanized regions may build more housing (and consume more land) than is desired. This (mis)allocation of growth in the GGH region could result in several outcomes.

1. **If the Growth Plan is successful at limiting growth in the Inner Ring in favour of growth in the Outer Ring,** 336,000 additional people will end up living in Outer Ring communities in 2041. These communities are beyond the Greenbelt, often requiring long commutes to jobs in the GTHA (because these regions do not have sufficient employment within their boundaries, as shown in section 4.6.1), and on average more car-dependent than Inner Ring communities. Many of them are already planning for lower densities than the minimum targets in the Growth Plan. If passed,

Amendment 1 will enshrine these weaker targets in provincial policy, eliminating the requirement for municipalities to plan at higher densities. The province will not be able to build enough roads to accommodate all the traffic this will create. The result will almost certainly be even more congestion, car use, GHG emissions, and loss of farmland and natural heritage areas – and even worse gridlock than we experience today.

2. **If fewer people decide to live in the distant suburbs than the Growth Plan allocations call for,** Outer Ring municipalities run the risk of over-designating land and making large infrastructure investments for growth that does not materialize. One analysis found that Outer Ring municipalities may set aside 80% more land than is needed, based on the lower (and potentially more accurate) MOF projections.[43] Aside from the irreplaceable loss of natural heritage areas and agricultural land, these municipalities may find themselves with a shortfall of several hundred millions of dollars if the development charges they rely on to help pay for infrastructure to support growth do not come about. A group of regional planning and public works commissioners warned about the scale and speed of planned growth outside Toronto, calling for greater flexibility[44] in meeting growth projections that "could save municipalities tens or hundreds of millions of dollars."[45] All this will have real and costly implications for current and future residents.

Figure 4.24. The Greater Golden Horseshoe is expected to grow by nearly 4 million people by 2041. The Growth Plan directs 1 million of these to Outer Ring communities – 50% more than projections from the Ministry of Finance. Many of these communities are far from employment centres and dependent on cars as a mode of travel. Instead of encouraging urban sprawl, the Growth Plan should remove barriers to increasing housing supply in existing urban areas to reduce the need to travel long distances by car.

4.3.5 The Growth Plan ignores employment trends

Another critical flaw is that the Growth Plan is "based on shockingly little hard evidence on the current and evolving economy of the region."[46] The Growth Plan directs the majority of growth to 25 "Urban Growth Centres" (Figure 4.25). These are intended to be focal points for investment in transit and services to "serve as high-density major employment centres" and "accommodate significant population and employment growth."[47] The Growth Plan expects all areas of the GGH to see job growth by 2041, and calls for re-urbanizing existing employment areas to provide a mix of residential, employment and other uses, at higher densities that support transit.

However, many of these Urban Growth Centres are experiencing little employment growth; outside downtown Toronto, all Urban Growth Centres had zero net growth between 2001 and 2011. Some Urban Growth Centres, such as older downtowns in Brampton, Brantford, and St. Catharines, have lost thousands of jobs.[48] Instead, there is a "hyper-concentration" of job growth in and around downtown Toronto (85,600 new jobs from 2006 to 2016), plus three large "megazones" and a number of smaller "suburban knowledge-intensive districts", which mainly consist of office parks. With the exception of downtown Toronto, these are not the areas where the Growth Plan called for employment growth. Many of them are low-density, single-use and extremely car-dependent. The three suburban megazones[49] alone generate an estimated 1 million car trips each day, with less than 5% of workers using transit to commute.

Credit: Josh Wilburne.

The growing disconnect between the Growth Plan's rosy assumptions and actual employment patterns seriously undermines the Growth Plan's prospects of reducing commute times and congestion. On the contrast, it is a recipe for growing gridlock, which the province will not be able to solve by building more roads.

While intensifying and revitalizing urban growth centres across the GGH is a worthy policy goal, many of these areas are struggling to attract significant office and other employment, and will continue to do so without

The growing disconnect between the Growth Plan's rosy assumptions and actual employment patterns is a recipe for growing gridlock.

frequent transit, urban design improvements, and other amenities to support such uses. Targeted investments can help to focus re-development and attract jobs in priority locations, i.e., those with existing transit and the potential for employment growth. Otherwise, the Growth Plan's emphasis on directing growth to a broad swathe of Urban Growth Centres risks creating more bedroom communities with few local employment opportunities, forcing residents into longer commutes by car.

It is also important to address the current auto-reliance of the suburban employment areas outside Toronto, representing more than 600,000 jobs (almost three times the number of jobs in Urban Growth Centres outside downtown Toronto). Many of these suburban employment areas are poorly served by transit and cross multiple municipal boundaries, further complicating planning. The province can play a stronger role in coordinating transit and land use planning in these areas to ensure that future transit investments reduce car use and provide workers with alternative commuting options. A new policy (2.2.5.14) in the 2017 Growth Plan grants the Minister powers to "identify certain areas that meet these criteria [large areas with high concentrations of employment that cross municipal boundaries and are major trip generators] and provide direction for a co-ordinated approach to planning."

In addition, Metrolinx's 2018 Regional Transportation Plan includes new frequent transit routes and commitments to improve access to Pearson Airport for passengers and workers (Pearson has the second-largest concentration of jobs in the province, and is one of the largest sources of regional congestion).[50] The Greater Toronto Airports Authority is planning for a new Regional Transit Centre (dubbed "Union Station West") to improve transit connectivity for airport workers, as well as passengers.

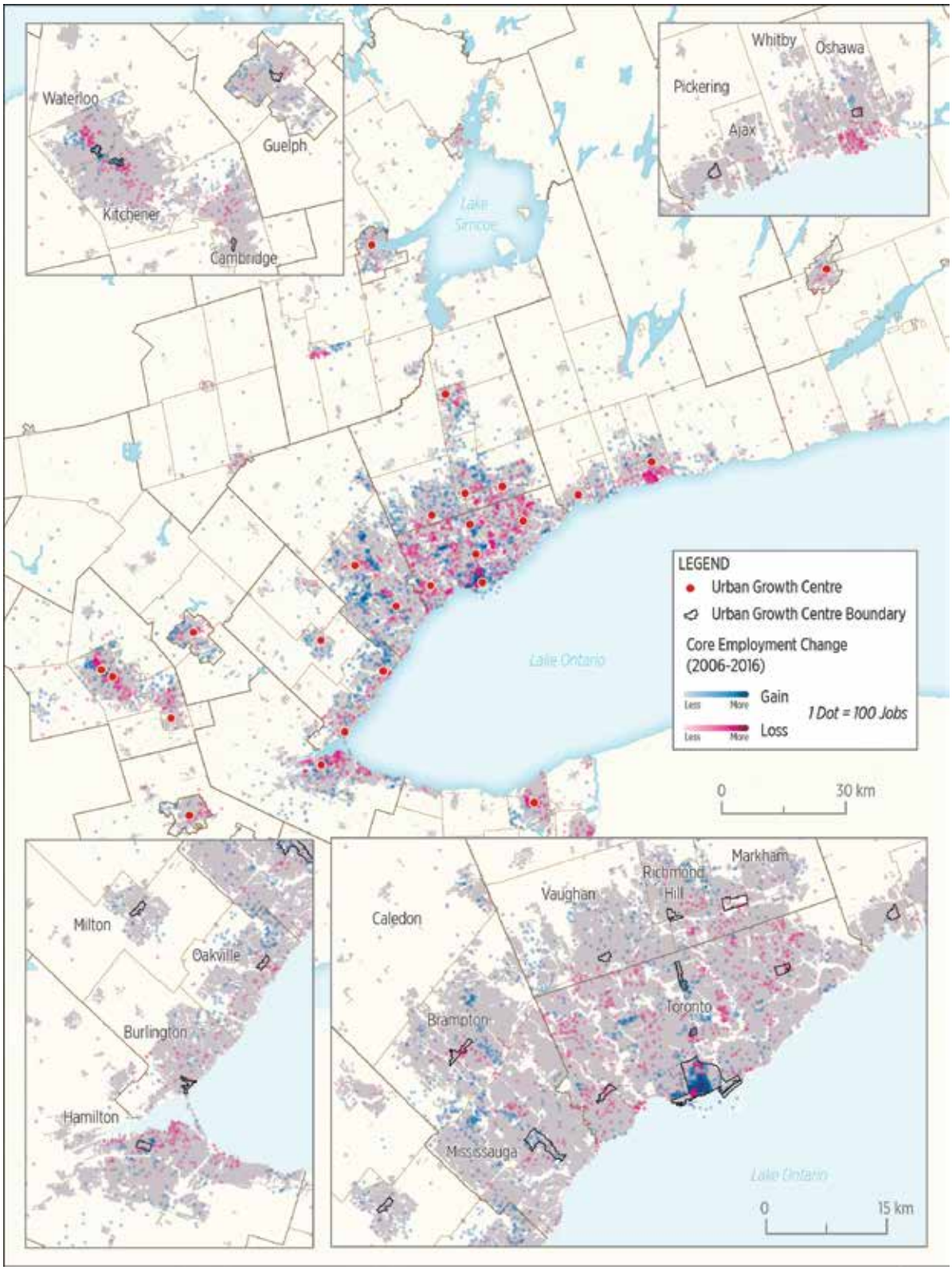


Figure 4.25. Employment gain (blue) and loss (pink) from 2006 to 2016 in the Greater Golden Horseshoe, overlaid with the Growth Plan's 25 "Urban Growth Centres" (red circles).

Source: Neptis Geoweb (neptisgeoweb.org).

Planning transit and growth together: Mississauga's Dundas Connects Plan

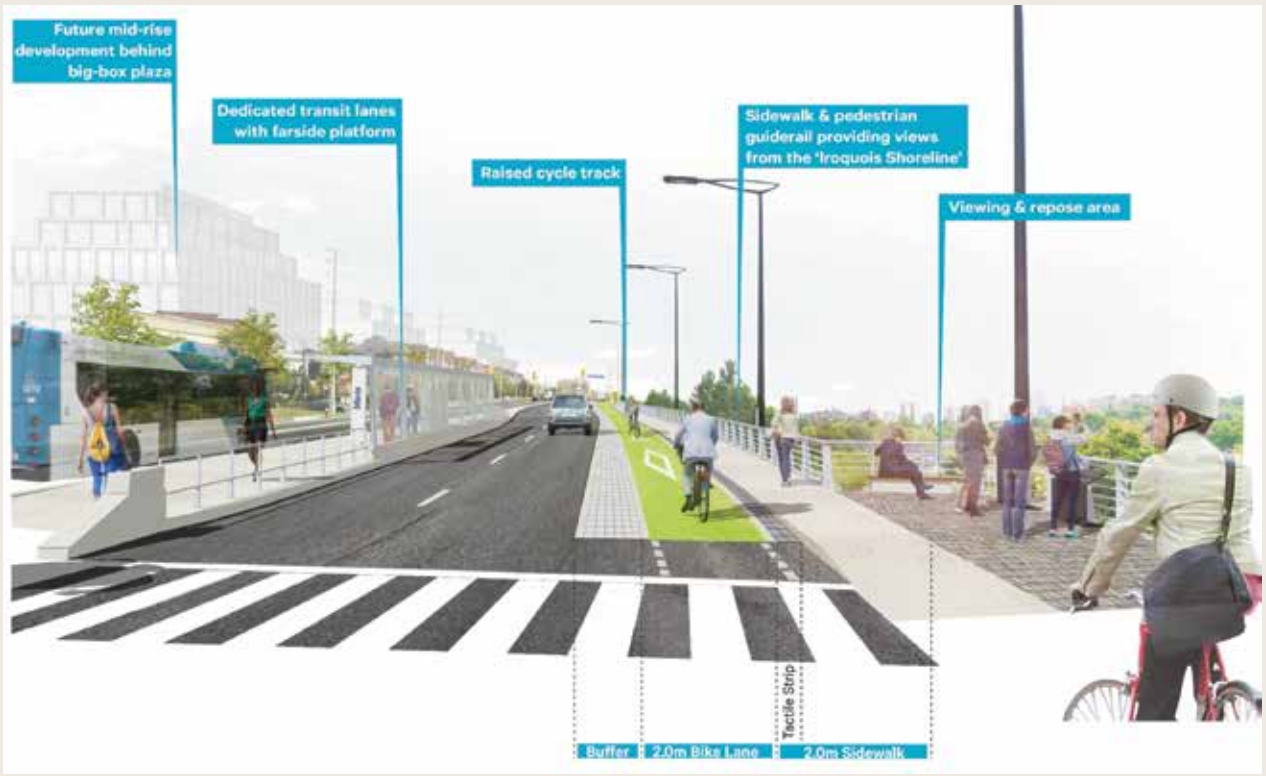
Mississauga is expecting to grow by more than 80,000 new residents by 2031. The city is almost fully built out, so must accommodate most of this growth through intensification. After decades of car-dependent sprawl, it is now attempting to grow in a more transit-friendly way. For example, it has made the removal of barriers to higher-density housing around transit one of its top five priorities to boost the supply of middle-income housing.

The city is also coordinating land use and transit planning more closely, through its Dundas Connects study. This is a master plan for the 20-km Dundas Street corridor that stretches from Oakville in the west to Toronto in the east. Although Dundas St. is largely low-rise, significant growth is expected over the next two decades and it is identified as a transit corridor by Metrolinx and the city. It also intersects with the planned Hurontario light-rail transit project, which is planned to open in 2022.

To develop the master plan, the city brought together a multi-disciplinary team from several departments and the provincial government (which provided funding through Metrolinx). The team studied the intensification potential and constraints at seven focal areas along the corridor, and consulted widely with local residents and businesses on various options. The final plan calls for higher density developments around future stations with a mix of housing, offices and retail, along with 70 hectares of new parks and public space, improved street connectivity and cycling infrastructure. Rather than decide in advance on the type of transit, the choice of bus rapid transit (BRT) emerged from studies and consultation. BRT was chosen as it is better suited to the urban form and has the potential to move people at a far lower cost than a subway (which would have been 10-12 times more expensive to build). The city predicts BRT will generate more than $840 million in net economic benefits.[51]

Above: Dundas Street now (looking east at Mavis Road) and the same location under the conceptual Dundas Connects plan (below).

Credit: Google Maps; City of Mississauga.



4.4 Proposed changes to the Growth Plan

In January 2019, the government proposed Amendment 1 to the Growth Plan, to roll back some of the 2017 changes.[52] According to the province, these changes will help to speed up the supply of housing and provide greater flexibility to municipalities and local planners. However, the changes will reduce greenfield density targets to below levels that support reliable transit, and unleash even more auto-centric development in communities far from employment centres. This will mean longer commutes and more congestion for more people with no practical alternative.

The key changes are summarized in Table 4.5.

Table 4.5. Key changes to Growth Plan policies proposed by Amendment 1.

Proposed policy	Change from existing policy	ECO Comment
Reduce designated greenfield area density targets	Lowered from 80 residents and jobs/ha to 40-60 residents and jobs/ha (varies between municipalities).	Densities of at least 80/ha required to support 10-15 minute bus service and reduce reliance on cars. Lower densities will lock in car dependency and are more costly to service.
Reduce intensification targets	Lowered from 60% to 50% or less in most municipalities; kept at 60% for Hamilton, Peel, York and Waterloo (which must now meet targets 10 years earlier). A number of Outer Ring municipalities have even lower targets (see text).	Fewer people will live in existing neighbourhoods close to transit, jobs and amenities. More growth will be accommodated through low-density suburbs built on agricultural land and natural heritage areas (urban sprawl).
Changes to major transit station areas (MTSA)	Municipalities can delineate and set targets for MTSAs prior to updating their official plans; MTSA densities now apply to a 500 to 800 metre radius (previously up to 500 metres).	Potential to speed up and simplify development around transit, and increase the number of people living within walking distance.
New policies for settlement boundary expansion	Municipalities can expand boundaries by 40 hectares multiple times, and make "adjustments" to boundaries (with no net increase in land) before completing a municipal comprehensive review (at which point any additional lands must be fully accounted for). Expansion criteria have been simplified.	Studies have found little evidence for a shortage of land supply in the GGH as a whole. Instead there is a large potential for 'missing middle' infill housing in areas with existing infrastructure and services.
Employment lands conversions	Providing a one-time window to allow municipalities to undertake some conversions in advance of the next municipal comprehensive review. Designating new "provincially significant employment zones."	May allow municipalities to plan mixed-use developments around transit stations, and recognize major suburban employment areas that require coordinated transit planning.

Source: Ontario Ministry of Municipal Affairs and Housing, Proposed Amendment 1 to the Growth Plan for the Greater Golden Horseshoe, 2017 (2019).

The weakening of intensification and greenfield density targets are most concerning for regional congestion and vehicle use. They will have the effect of allowing more residential growth to occur outside existing built-up areas, with that growth at lower densities. As Table 4.6 shows, many Outer Ring municipalities will now be expected to meet intensification targets of less than 40% (as low as 15% for Brant County and 20% for Wellington County), a major reduction from the 60% target set by the 2017 Growth Plan (with an interim target of 50% to 2031). The amendment makes similar reductions in greenfield density targets, from 80 people and jobs/ha to 40-50 people and jobs/ha for many Outer Ring municipalities. (MMAH says that these reduced targets are "intended to eliminate alternative targets", but Amendment 1 maintains the policies allowing municipalities to request alternatives, and removes several important criteria, including the requirement that alternatives can only be requested through a municipal comprehensive review).[53]

There are valid concerns that applying a greenfield density target of 80 people and jobs/ha is difficult to achieve for some municipalities. For example, the 2017 Growth Plan applied the density target over the entire greenfield area, rather than just expansion areas. Since much of the existing greenfield area was already planned at lower densities, in some cases this forced municipalities to overcompensate by planning newer areas (often on the urban edge) at much higher densities.[54]

Instead of addressing this issue (for example, by allowing the 80/ha target to apply only to greenfield expansion areas, rather than across the entire designated greenfield area), the proposed amendment reduces densities to the point where cost-effective transit will no longer be viable across large swathes of the new greenfield area. Even in more urbanized areas, the province has reduced density targets to levels that will barely support transit. For example, Halton and Durham Regions were allocated additional growth of 320,000 between 2016 and 2041 (over and above the MOF projections), but now have reduced density targets of 50 people and jobs/ha.

A walkable mid-rise development in Waterloo.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

Table 4.6. Proposed changes to the Growth Pan's intensification and density targets under Amendment 1.

Note: City of Toronto not included as 100% of its growth is through intensification and it has no designated greenfield area.

Category	Municipalities	Growth Plan forecast population growth (2016-2041)	Intensification target (%)		Greenfield density target (people and jobs/ha)	
			Current	Proposed	Current	Proposed
A	City of Hamilton Region of Peel Region of Waterloo Region of York	1,645,800	50 until 2031; 60 after 2031	60	80	60
B	Region of Durham Region of Halton Region of Niagara City of Barrie City of Brantford City of Guelph City of Peterborough City of Orillia	1,390,600	50 until 2031; 60 after 2031	50	80	50
C	City of Kawartha Lakes County of Brant County of Dufferin County of Haldimand County of Northumberland County of Peterborough County of Simcoe County of Wellington	338,000	50 until 2031; 60 after 2031	Maintain / improve upon target in official plans (range from 15% to 40%)	80	40

Source: Ministry of Municipal Affairs and Housing, Proposed Amendment 1 to the Growth Plan (2017).

4.4.1 Amendment 1 will lead to longer, more congested commutes

The current Growth Plan projects an increasing number of commute trips from the Outer Ring to the Inner Ring. The number of net trips (i.e., outbound minus inbound trips) rises from about 92,000/day in 2016 to more than 131,000/day in 2041. As figure 4.26 shows, the bulk of this increase is expected to come from the northern Outer Ring (i.e., Simcoe County, Barrie, Orillia and Dufferin County).[55]

This will increase the number of commuters using already congested roads and highways, resulting in higher levels of air and climate pollution and more gridlock. Metrolinx modeling also projects a doubling or tripling of congested vehicle-km travelled from 2011 to 2041 (depending on the level of implementation of the Regional Transportation Plan).[56]

Amendment 1 will increase the number of commuters using already congested roads, resulting in higher levels of air and climate pollution and more gridlock.

Because the Growth Plan will put ever more homes far from where the jobs are, the proposed Amendment 1 will further increase the number of people commuting by car from the Outer Ring to the Inner Ring. Weaker targets for Outer Ring municipalities (both intensification rates and greenfield densities) could lead to many more residents living in new greenfield developments that are planned at densities too low to support transit, requiring more land and costly supporting infrastructure.

Projected commuting patterns from Outer Ring municipalities, 2001-2041

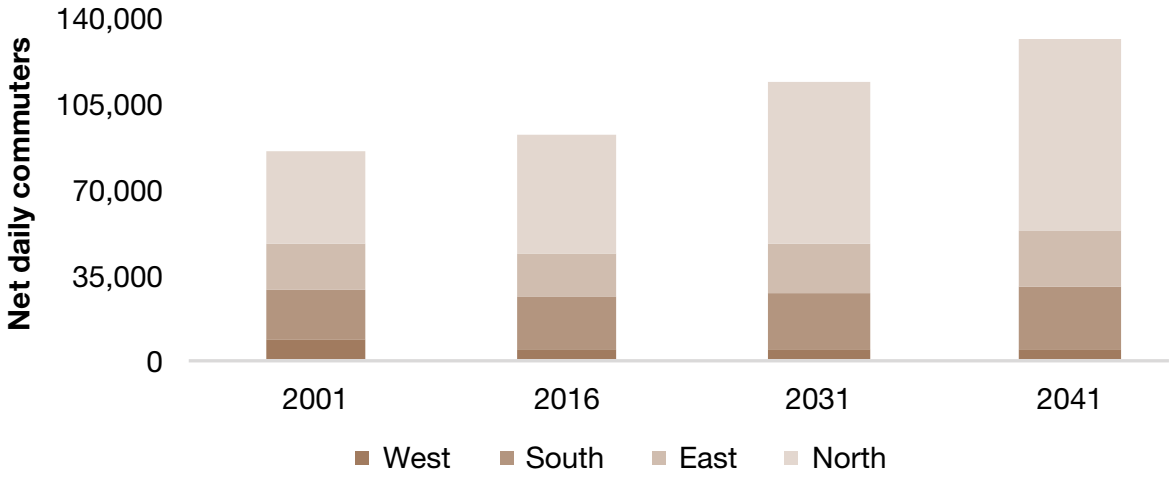


Figure 4.26. Commuting patterns from Outer Ring municipalities between 2001 and 2041 (forecast). Northern Outer Ring municipalities (the Cities of Barrie and Orillia and Counties of Simcoe and Dufferin) will see the largest net increases in commuters travelling to the Inner Ring.

Source: Hemson Consulting Ltd, GGH Growth Forecasts to 2041, Technical Report (November 2012) Addendum, June 2013, Table 59 (Appendix B).

Municipal tools to reduce car travel

Municipalities can plan above the province's reduced density and intensification targets. After all, these are minimum targets – and municipalities are encouraged to go beyond these "to address matters of importance."[57] The impacts of car use and sprawl (including congestion, pollution, health costs, and GHG emissions) are clearly matters of importance, plus a crushing financial burden for municipalities.[58]

What else can municipalities do to make car travel less necessary? Below are some tools that Ontario municipalities are already using.

1. **Eliminate parking standards** – many municipalities require new developments to include a minimum number of parking spaces per residential unit (generally between 1-2 spaces per unit). In denser neighbourhoods, each underground parking space can add $60,000 to development costs.[59] Reducing or eliminating minimum parking standards can lower housing costs, speed up transit-supportive development, and encourage people to use transit or active transportation instead of driving. As part of its new Downtown Plan, the City of Hamilton is eliminating parking requirements for buildings with fewer than 12 units, and reducing parking minimums for other residential and commercial buildings. These changes are part of a suite of policies to encourage higher density development around the city's $1-billion light rail transit project.

2. **Dedicate road space for transit** – creating dedicated transit lanes (e.g., bus rapid transit) can improve the efficiency of the road network (as public transit has a higher throughput than car traffic) and increase the reliability and ridership of municipal transit systems. Several Ontario municipalities have implemented, or are planning, bus rapid transit networks (including the Viva Rapidway in York Region, Brampton's Züm, Mississauga's Transitway, and London's Shift). BRT can spur higher density development around stations and along corridors. For example, Markham has seen rapid development along Highway 7 since the 2013 opening of its BRT, and Mississauga is co-ordinating higher-density, mixed-use development along the route of its planned Dundas Street BRT.

York Region's VIVA bus rapid transit system connects Markham, Richmond Hill and Vaughan.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

3. **As-of-right zoning around transit** – zoning bylaws often limit higher density development in areas where it is most needed (i.e., along transit corridors). Re-zoning is a costly, time-consuming process, and is currently needed for 62% of new developments in the GGH.[60] This is a barrier to increasing housing supply where it is most needed. As-of-right (AOR) zoning is a proactive process that involves local community members and developers to collaboratively set a vision for how the neighbourhood will grow, negotiate community benefits up front, and create long-term certainty for new developments. Several municipalities are pre-zoning areas for higher densities along planned light rail transit (LRT) corridors. The City of Hamilton introduced

new transit-oriented corridor zoning categories along the B-Line LRT corridor. Each transit-oriented corridor zone has a specific mix of uses, height minimums/maximums, and other regulations to take into account local context while encouraging transit-supportive densities. Waterloo Region and the City of Kitchener have developed plans to guide growth along the ION LRT corridor, including changes to land use and zoning to encourage higher-density development in strategic areas. The province can encourage more municipalities to follow suit by requiring pre-zoning for supportive densities along transit corridors as a condition of transit funding.

An example of transit-supportive density in Hamilton.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

4. **Build protected bike lanes** – there is huge potential to replace car trips with cycling. According to the 2016 Census, 33% of Ontarians commute less than 5 km to work, a distance that could reasonably be cycled. In the GTHA, about 4.35 million daily trips are potentially cyclable – more than 30 times the current number.[61] The lack of dedicated cycling infrastructure is a key reason why more people do not cycle. Cities are starting to build networks of protected bike lanes, while also reducing speed limits and providing more bike parking, to encourage more people to ride. For example, Hamilton expanded its bike lane network by 85% since 2009,[62] and Mississauga is developing a cycling network after the number of cycling trips doubled since 2011. Across Ontario, 40 municipalities have been named "Bicycle Friendly Communities" by the Share the Road Cycling Coalition.

Separated cycle tracks on Richmond Street in Toronto provide a safer option for people wanting to bike.

Credit: Queen's Printer for Ontario, photo source: Ontario Growth Secretariat, Ministry of Municipal Affairs and Housing.

4.5 Conclusion and recommendations

Ontario's rapid growth combined with car-centric planning continues to result in longer commutes, more gridlock, and rising fossil fuel use. GHG emissions from personal vehicles are equal to emissions from all Ontario's heavy industry or buildings sectors, and they continue to rise. Yet Ontario has no plan or targets to reduce GHGs from automobiles. Instead, its signature policy for managing population growth – the Growth Plan for the Greater Golden Horseshoe – is enabling more auto-dependent sprawl.

Land use planning that follows best practices can reduce congestion and pollution by making travel in private cars less necessary, and by making alternatives more practical, pleasant and convenient.

Land use planning that follows best practices can reduce congestion and pollution by making travel in private cars less necessary, and by making alternatives more practical, more pleasant and more convenient. This is a long-term process. Decisions made today lock in energy, growth and transport patterns for decades. If the government corrects the flaws in its current policies, it will save money for municipalities and residents, reduce vehicle use and congestion, improve public health and reduce air and climate pollution.

This chapter's main findings are:

1. More housing should be built – in existing neighbourhoods with access to transit and jobs

New housing is needed to accommodate a growing population. However, its location and type is critical. Higher-density housing along transit corridors will provide higher ridership and reduce traffic congestion, providing revenue for transit operators to improve service and capacity. Missing middle housing can fill the gap between condo towers and suburban detached homes, providing affordable family-friendly housing with lower energy use and revitalizing existing neighbourhoods.

Municipalities have a number of tools to support these kinds of housing; the province can encourage this with a mix of carrots and sticks.

2. Growth Plan population allocations to the Outer Ring are too high

The population allocations in the Growth Plan direct municipalities to put one million people in communities beyond the Greenbelt. Many of these communities are car-dependent, far from employment and have low densities that will not support transit. Residents of these suburbs will be locked into heavy fossil fuel use, with longer commutes, more congestion, higher taxes and energy costs, more air and climate pollution, and less natural heritage and farmland.

These Growth Plan allocations are not justified by market demand for housing. There is more than enough land available for housing within existing urban areas (see above). In fact, the Growth Plan is pushing Outer Ring municipalities to put aside land and build infrastructure for 50% more people than may move there, at enormous wasted expense.

3. Province plans to further weaken the Growth Plan

If the existing Growth Plan were not doing enough harm, the province's proposed changes will make it worse. They will make it easier for municipalities to build yet more low-density, high-fossil fuel sprawl and expand urban boundaries, with less public consultation and oversight.

4. No one knows: is the Growth Plan working?

In accordance with best practices, the Growth Plan requires the Minister of Municipal Affairs and Housing to monitor and report on its effectiveness. Since 2006, the province has only done so once, in 2015. Without regular, credible reports and appropriate indicators, no one knows what impact the Growth Plan is having on Ontario's economy, climate and well-being.

4.5.1 Recommendations

The ECO recommends that the government provide homes and jobs for the growing population, without locking them into sprawl, congestion and gridlock, by:

- **Removing regulatory obstacles to adding density into areas with existing transit and jobs, thus creating more housing in compact, complete communities with a lower total cost of living.**

  - **The ECO recommends that the Ministry of Municipal Affairs and Housing amend the Planning Act to require municipalities to allow missing middle housing (e.g., duplexes, triplexes, townhouses) in residential neighbourhoods.**

  - **The ECO recommends that the Ministry of Municipal Affairs and Housing clarify and enforce policies in the Growth Plan that encourage intensification throughout the built-up area.**

  - **The ECO recommends that the Ministry of Municipal Affairs and Housing require municipalities to undertake studies to better understand housing potential in existing built-up areas, before approving updates to Official Plans.**

- **Revising population allocations in the Growth Plan to direct much more growth towards these compact communities.**

  - **The ECO recommends that Ministry of Municipal Affairs and Housing revise the Growth Plan population allocations in Schedule 3 to limit future residential growth in suburban and Outer Ring communities to what is in line with local employment potential, and instead direct more growth to urbanized communities with existing transit, infrastructure and jobs.**

- **Limiting development of new suburbs and requiring them to have densities of residents and jobs that support frequent transit.**

  - **The ECO recommends that the Ministry of Municipal Affairs and Housing not proceed with proposed Amendment 1 policies that would weaken intensification and greenfield density targets.**

  - **The ECO recommends that the Ministry of Municipal Affairs and Housing freeze urban boundary expansions until municipalities have demonstrated a clear need for land beyond the current designated greenfield area.**

  - **The ECO recommends that the Ministry of Municipal Affairs and Housing follow a transparent and consultative process for all municipal requests for alternative targets.**

- **Requiring transit-supportive densities around transit stations and corridors as a condition of provincial funding.**

  - **The ECO recommends that the Ministry of Municipal Affairs and Housing and the Ministry of Transportation coordinate land use and transportation planning decisions, and require that municipalities reduce barriers to higher densities around transit before funding is released (e.g., through as-of-right zoning, eliminating minimum parking standards, and other tools).**

- **Regular, credible reporting of the Growth Plan's performance in sustainably managing growth.**

  - **The ECO recommends that the Ministry of Municipal Affairs and Housing release annual progress reports on key targets in the Growth Plan for the Greater Golden Horseshoe, create an online website/dashboard for the public and stakeholders to view progress, and update its performance indicators to include more sustainable transportation indicators (e.g., per capita vehicle-kilometres travelled).**

Endnotes

1. Environmental Commissioner of Ontario, "Freight Trucks" in Ontario's Climate Act: From Plan to Progress, Annual Greenhouse Gas Progress Report 2017 (Toronto: ECO, January 2018).
2. Ashton Ruby Taylor, Applying life cycle assessment to analyze the environmental sustainability of public transit modes for the City of Toronto, Master of Science thesis (Kingston: Queen's University, 2016).
3. Toronto Transit Commission, "Unlocking Gridlock" (February 28, 2019) online: <www.ttc.ca/About_the_TTC/Operating_Statistics/2017/section_two.jsp>
4. Todd Litman, Evaluating Transportation Land Use Impacts: Considering the Impacts, Benefits and Costs of Different Land Use Development Patterns (Victoria: Victoria Transport Policy Institute, 2018).
5. Passenger-kilometres refers to the number of kilometres driven divided by the average number of passengers. This figure includes cars, sports utility vehicles (SUVs), and passenger trucks, and does not include travel by bus, motorcycle or non-passenger road modes (e.g., freight trucks). See: Natural Resources Canada, Comprehensive Energy Use Database, Transportation Sector – Ontario, Tables 20 and 25.
6. Statistics Canada, New motor vehicle sales, by type of vehicle, Table: 20-10-0002-01 (Ottawa: Statistics Canada, 2018).
7. Brookings Institution, Driving in the 21st century: Current trends, future needs by Tony Dutzik et al. (Washington, DC: Brookings Institution, 2015); Commission on Travel Demand, All Change? The future of travel demand and the implications for policy and planning by Marsden, G. et al. (Leeds, UK: 2018).
8. Statistics Canada, Census Profile, 2016 Census, Ontario – Journey to work (Ottawa: Statistics Canada, 2016).
9. Jared VandeWeghe & Christopher Kennedy, "A Spatial Analysis of Residential Greenhouse Gas Emissions in the Toronto Census Metropolitan Area" (2007) 11:2 Journal of Industrial Ecology 133-144.
10. Schaller Consulting, The New Automobility: Lyft, Uber and the Future of American Cities by Bruce Schaller (New York City: Schaller Consulting, 2018).
11. Neptis Foundation, Shaping the Toronto Region: Past, Present and Future by Zack Taylor and John van Nostrand (Toronto: Neptis, 2008) at 24.
12. David Gordon, "Canadian Suburbs", online: Queen's University <http://canadiansuburbs.ca/index.html>. [Accessed 15 January 2019].
13. Neptis Foundation, Growing Pains: Understanding the new reality of population and dwelling patterns in the Toronto and Vancouver regions by Marcy Burchfield & Anna Kramer (Toronto: Neptis, 2015) at 16.
14. The Canadian Centre for Economic Analysis, Understanding the forces driving the shelter affordability issue (Toronto, 2017).
15. Cheryll Case and Tetyana Bailey, Protecting the Vibrancy of Residential Neighbourhoods (Toronto: 2017).
16. Canada Mortgage and Housing Corporation, GTA Location and Commuting Choices: The Effect of Commutes on Lower Priced Suburban Housing by A. Scott and J. Nanowski (Ottawa: CMHC, 2018).
17. Todd Litman, "Unaffordability Is a Problem, but Sprawl Is a Terrible Solution", The City Fix (March 31, 2017), online: <http://thecityfix.com/blog/unaffordability-is-a-problem-but-sprawl-is-a-terrible-solution-todd-litman/> [accessed February 20, 2019].
18. Canadian Centre for Economic Analysis, The GTHA's Unbalanced Housing Stock: Benchmarking Ontario's New LPAT System (Vaughan: RCCAO, 2018).
19. Ryerson City Building Institute, Getting Intense: Rethinking Planning for an Intensification First Approach by Graham Haines and Brianna Aird (Toronto: 2018).
20. Evergreen and Canadian Urban Institute, What is the Missing Middle? A Toronto housing challenge demystified, by Jeff Evenson, Ariana Cancelli, and Keir Matthews-Hunter (Toronto: 2018).
21. Ryerson City Building Institute and The Atmospheric Fund, Submission to Consultation on Increasing Housing Supply in Ontario (Toronto: January 25, 2019).
22. Single-tier municipalities include the Cities of Toronto and Hamilton; upper-tier municipalities are made up of two or more lower-tier municipalities (i.e., towns or cities). They can be regions (e.g., Regions of Peel, York and Durham) or counties (e.g., Counties of Wellington and Northumberland).
23. Bill 68, Modernizing Ontario's Municipal Legislation Act, 2017.
24. Neptis Foundation, Implementing the Growth Plan for the GGH: Has the strategic regional vision been compromised? by Rian Allen and Philippa Campsie (Toronto: Neptis, 2013).
25. Nicola Crawhall and Associates, Implementing the Growth Plan: Seeking Provincial and Municipal Alignment to Support a Prosperous Ontario (Toronto: RPWCO, 2015); Ontario Ministry of Municipal Affairs, Performance Indicators for the Growth Plan for the Greater Golden Horseshoe, 2006 (Toronto: MMAH, 2015).
26. Ontario Ministry of Municipal Affairs and Housing, information provided to the ECO (February 8, 2019).
27. Ontario Ministry of Municipal Affairs and Housing, Performance Indicators for the Growth Plan for the Greater Golden Horseshoe, 2006 (Toronto: MMAH, 2015).
28. Stakeholder communication, February 11, 2019.
29. Nicola Crawhall and Associates, Implementing the Growth Plan: Seeking Provincial and Municipal Alignment to Support a Prosperous Ontario (Toronto: RPWCO, 2015).
30. Ontario Ministry of Municipal Affairs and Housing, Performance Indicators for the Growth Plan for the Greater Golden Horseshoe, 2006 (Toronto: MMAH, 2015).
31. Ontario Ministry of Municipal Affairs and Housing, Performance Indicators for the Growth Plan for the Greater Golden Horseshoe, 2006 (Toronto: MMAH, 2015) at 8.
32. Ontario Ministry of Municipal Affairs and Housing, Performance Indicators for the Growth Plan for the Greater Golden Horseshoe, 2006 (Toronto: MMAH, 2015) at 11.
33. Neptis Foundation, Growing Pains: Understanding the new reality of population and dwelling patterns in the Toronto and Vancouver regions by Marcy Burchfield and Anna Kramer (Toronto: Neptis, 2015).
34. Government of Ontario, A Growth Plan for the Greater Golden Horseshoe: Discussion Paper (Toronto: MMAH, 2004) at 5.
35. Neptis Foundation, Implementing the Growth Plan for the GGH: Has the strategic regional vision been compromised? by Rian Allen and Philippa Campsie (Toronto: Neptis, 2013).

36. Advisory Panel for the Coordinated Review of the Growth Plan, Greenbelt Plan, Oak Ridges Moraine Conservation Plan, and Niagara Escarpment Plan, Planning for Health, Prosperity and Growth in the Greater Golden Horseshoe: 2015-2041 by David Crombie et al (Toronto: December 2015).

37. Ontario Ministry of Municipal Affairs and Housing, Proposed Amendment 1 to the Growth Plan for the Greater Golden Horseshoe, 2017 (Toronto: MMAH, January 2019).

38. Data in this text box are from the Transportation Tomorrow Survey, University of Toronto Transportation Research Institute (2016).

39. Ontario Ministry of Transportation, Greater Golden Horseshoe Transportation Plan – Transportation Profile (Toronto: MTO, 2017).

40. Ontario Ministry of Finance, Ontario Population Projections Update, 2017–2041 (Toronto: MOF, Spring 2018).

41. Friends of the Greenbelt Foundation, Plan to Achieve: A Review of the Land Needs Assessment Process and the Implementation of the Growth Plan by Kevin Eby (Toronto: Friends of the Greenbelt Foundation, 2016).

42. Centre for Urban Research and Land Development, Are the Growth Plan Population Forecasts on Target? By Frank Clayton and Colin Wolfe (Toronto: Ryerson University, 2015).

43. Friends of the Greenbelt Foundation, Plan to Achieve: A Review of the Land Needs Assessment Process and the Implementation of the Growth Plan by Kevin Eby (Toronto: Friends of the Greenbelt Foundation, 2016).

44. MMAH says that proposed Amendment 1 "aims to provide greater flexibility" (MMAH, information provided to the ECO, February 12, 2019). However, this flexibility largely applies to municipalities' ability to reduce intensification and density targets, and expand urban boundaries – in effect spreading the same amount of development out over a larger area. Amendment 1 still requires municipalities to plan for the previous unrealistic growth forecasts in Schedule 3.

45. Nicola Crawhall and Associates, Implementing the Growth Plan: Seeking Provincial and Municipal Alignment to Support a Prosperous Ontario (Toronto: RPWCO, 2015); Ontario Ministry of Municipal Affairs, Performance Indicators for the Growth Plan for the Greater Golden Horseshoe, 2006 (Toronto: MMAH, 2015).

46. Pamela Blais, Planning for Prosperity: Globalization, Competitiveness, and the Growth Plan for the Greater Golden Horseshoe (Toronto: Neptis, 2015).

47. Ontario Ministry of Municipal Affairs and Housing, Growth Plan for the Greater Golden Horseshoe (2017) section 2.2.3.

48. Pamela Blais, Planning for Prosperity: Globalization, Competitiveness, and the Growth Plan for the Greater Golden Horseshoe (Toronto: Neptis, 2015).

49. The "Airport Megazone" (around Pearson Airport), "Tor-York East" (Highway 404/407 interchange in Markham, Richmond Hill and Toronto), and "Tor-York West" (Highway 400-Keele Street in Vaughan and Toronto). See Blais, Planning for Prosperity, 2015 for more information.

50. See Priority Action 2.5 in Metrolinx, Regional Transportation Plan (Toronto: Metrolinx, 2018) at 72.

51. City of Mississauga, Dundas Connects Master Plan (Mississauga, 2018).

52. Ontario Ministry of Municipal Affairs and Housing, Proposed Amendment 1 to the Growth Plan for the Greater Golden Horseshoe, 2017 (Toronto: MMAH, January 2019).

53. Policies 2.2.2.4 and 2.2.7.4 in Proposed Amendment 1 to the Growth Plan for the Greater Golden Horseshoe (2017).

54. For example, see Figure 6 in Malone Given Parsons, Ltd., Getting the Growth Plan Right (Markham: MGP, 2017).

55. Hemson Consulting Ltd., Greater Golden Horseshoe Growth Forecasts to 2041: Technical Report (November 2013) Addendum (Toronto: Hemson, June 2013) at 89.

56. AM peak congested vehicle-km travelled (VKT): 3.7 million in 2011, 8.1 million in 2041 (with planned transit), 11.1 million in 2041 (under 'Do Minimum' scenario); see Metrolinx, 2041 Regional Transportation Plan for the Greater Toronto and Hamilton Area, Draft Final (Toronto: Metrolinx, 2018) at 96.

57. See sections 1.2.3 and 5.2.5 in Ontario Ministry of Municipal Affairs and Housing, Growth Plan for the Greater Golden Horseshoe (2017).

58. Municipalities also have expanded powers under Bill 68, the Modernizing Ontario's Municipal Legislation Act (2017) to pass local bylaws "respecting the economic, social and environmental wellbeing of the municipality, including respecting climate change" (Municipal Act, 2001, P5, s 10(2)); municipalities can also undertake long-term energy and climate planning. Bill 68 also amended the Planning Act to include "the mitigation of greenhouse gas emissions" as a matter of provincial interest (Planning Act, 1990, 11 (1) s 2).

59. Pembina Institute and Ontario Home Builders Association, Make Way for Mid-Rise by Cherise Burda & Mike Collins-Williams (Toronto: Pembina Institute, 2015).

60. Fraser Institute, New Homes and Red Tape in Ontario: Residential Land-Use Regulation in the Greater Golden Horseshoe by Kenneth Green et al (Toronto: Fraser Institute, 2016).

61. Ryerson University and Toronto Centre for Active Transportation, Cycling Behaviour and Potential in the Greater Toronto and Hamilton Area by Mitra et al. (Toronto: Ryerson, 2016).

62. City of Hamilton, Cycling Master Plan Review and Update (Hamilton: 2018).

Appendix A: Energy conservation policy in 2017 and 2018

Abstract

Significant changes to the energy policy landscape in Ontario occurred in 2017 and 2018. Related changes to climate change policy are described in more detail in the ECO's 2018 climate change report Climate Action in Ontario: What's Next?[1]

With a focus on key developments in 2017 and 2018 impacting energy conservation and fuel switching to or from cleaner energy sources, some of the most important events were:

- The Fair Hydro Plan reduced electricity bills for smaller Ontario electricity consumers by 25% by financing a share of electricity system costs, to be repaid by future electricity ratepayers. Lower rates may reduce the incentive for customers to conserve electricity; however the Plan also included a new Affordability Fund that installs energy-saving measures for households who are not eligible for the low-income Home Assistance Program and who cannot undertake energy efficiency improvements without support.

- The Ministry of Energy, Northern Development and Mines released a new Long-Term Energy Plan in October 2017, which made no new electricity supply commitments, but reaffirmed a long-term commitment to electricity conservation. The Plan largely ignored fuels other than electricity.

- Renewable electricity development came to a halt as the Minister of Energy, Northern Development and Mines issued a directive to IESO to wind down renewable electricity contracts in the early stages of development, including 751 renewable contracts (216 of which had Indigenous participation), repealed the Green Energy Act, and revoked regulatory changes that would have expanded opportunities for customers to participate in the generation of renewable electricity through net metering. The drop in clean electricity supply due to these changes may make it more difficult to use Ontario's clean electricity system to reduce fossil fuel use through electrification in the future.

- Ontario's cap and trade policy, which increased the relative prices of fossil-fuel intensive energy sources, was implemented in 2017 and repealed in 2018. In addition, programs (including many energy efficiency and fuel switching programs) that were based on the funding from cap and trade revenues were established in 2016 and 2017, and cancelled in 2018. The Ontario government then released a new draft Environment Plan with substantially less stringent greenhouse gas emission targets and no form of carbon pricing for most emitters.

- Union Gas and Enbridge Gas Distribution merged into one company that covers most natural gas customers in Ontario. In addition, the government passed Bill 32, The Access to Natural Gas Act, 2018 which will enable the expansion of the natural gas network to unserved customers, with the costs of the expansion to be subsidized by existing gas customers. This may lock in an increase in fossil fuel use.

- Mid-term reviews for electricity and gas conservation programs were completed. For natural gas conservation, only minor changes will be made by the Ontario Energy Board before 2020, while the government's draft Environment Plan proposes an expansion of natural gas conservation beyond 2020. Future plans for electricity conservation are not known.

- Actions to reduce the use of gasoline and diesel included higher provincial requirements for ethanol in gasoline and the development of a federal Clean Fuel Standard. However, provincial initiatives to support vehicle electrification, including incentives for electric vehicle purchase, were cancelled.

- Annual requirements for energy and water reporting for large private buildings were introduced to help customers understand their energy and water use, benchmark to similar buildings, and identify opportunities to save energy and water. Steps were also taken to give more customers the ability to access their energy data through the Green Button standard.

Contents

Key developments in 2017 and 2018 with potentially significant impacts on energy conservation in Ontario are covered below. This includes initiatives that affect the conservation and use of fossil fuels by influencing fuel switching to or from cleaner energy sources, particularly electricity. The change in government in June 2018 had a significant impact on provincial energy policy, with some key initiatives introduced earlier in 2017 or 2018 being cancelled or reversed.

A.1 The Fair Hydro Plan

The Fair Hydro Plan Act, 2017 was a suite of changes that reduced electricity bills for smaller Ontario consumers eligible for the Regulated Price Plan. Reductions for average residential consumers were 25% in 2017 and limited increases to inflation until 2021. In general, the Fair Hydro Plan reduced bills by rebating the provincial 8% portion of the Harmonized Sales Tax on electricity bills back to ratepayers, transferring electricity support programs from the rate base to the tax base, and most significantly, refinancing a portion of current electricity system costs (Global Adjustment), to be paid back by future ratepayers. After 2021, electricity bills are expected to climb 6.8% per year until 2027. After 2027, electricity bills are expected to be 4% higher than without the Fair Hydro Plan Act. The Financial Accountability Office estimates a net cost to Ontarians of $21 billion over the 29 years after the Fair Hydro Plan Act was enacted.[2] The overall impact is lower electricity bills for Ontarians in the short-term but significantly higher costs in the long term.

The near-term reduction in electricity rates may reduce the incentive for some customers to invest in electricity conservation; however, it also reduces the near-term cost of switching from cheaper fossil-fuelled energy sources (such as natural gas) to electricity.

The Fair Hydro Plan's cut to electricity rates is being continued, but changes to the financing component are proposed.

The Fair Hydro Plan also included a $100 million fund (the Affordability Fund) that supports the free installation of energy saving measures for people who do not quite qualify for low-income conservation programs but who also cannot undertake energy efficiency improvements without support.[3]

The Fair Hydro Plan's cut to electricity rates is being continued, but changes to the financing component are proposed. The current government has stated intentions in its 2018 Fall Statement to cancel the Global Adjustment refinancing component as designed and to use government funding to maintain electricity rates at the (lower) level that had been enabled through the Fair Hydro Plan.[4] This will effectively transfer some of the cost of operating the electricity system to taxpayers.

Table A.1. Key activities related to the Fair Hydro Plan in 2017.

Activity	Date
Ontario Fair Hydro Plan Act, 2017 is passed.	June 1, 2017
Regulated Price Plan prices begin reflecting the changes from the Ontario Fair Hydro Plan Act.	July 1, 2017
The Affordability Fund is launched.	October 24, 2017

A.2 New Long-Term Energy Plan

Ontario's 2017 Long-Term Energy Plan was released on October 26, 2017 with implementation plans by the Independent Electricity System Operator (IESO) and Ontario Energy Board (OEB) released in subsequent months. A few notable conservation-related aspects from the plan include:

- continuing commitment to long-term (2032) provincial electricity conservation target,
- no immediate commitments to new electricity supply, and an intention to use market mechanisms for future electricity needs (potentially including some forms of conservation),
- a focus on innovation to balance fluctuations in electricity supply and demand, including consideration of energy storage technologies, funding for demonstration projects, and integration of electric vehicles into the electricity system. These efforts have the potential to reduce electricity waste and displace the use of fossil fuels, and
- a focus on improving energy supply and conservation to First Nation and Métis communities.[5]

The Long-Term Energy Plan did not set conservation targets for other fuels besides electricity, and took only very limited steps to encourage electrification of end uses currently met by fossil fuels, such as heating and transportation. The ECO had previously recommended ways to improve the Long-Term Energy Plan in a special 2016 report, Developing the 2017 Long-Term Energy Plan,[6] but few of these were implemented.

Table A.2. Key activities related to the Long-Term Energy Plan in 2017 and 2018.

Activity	Date
The Ministry of Energy, Northern Development and Mines publishes the 2017 Long-Term Energy Plan.	October 26, 2017
OEB publishes its 2017 Long-Term Energy Plan Implementation Plan.	January 31, 2018
IESO publishes its 2017 Long-Term Energy Plan Implementation Plan.	January, 2018
Minister of Energy, Northern Development and Mines approves IESO's Long-Term Energy Plan implementation plan.	February 15, 2018

A.3 Renewable electricity wind down

After the release of the Long-Term Energy Plan and the change in provincial government, on July 13, 2018, the Minister of Energy, Northern Development and Mines issued a directive to IESO to wind down renewable electricity contracts. The directive affected projects procured under the Feed-in Tariff and Large Renewable Procurement initiative that were in the early stages of development. The projects had not been issued a Notice to Proceed under their Feed-in Tariff contracts and projects with Large Renewable Procurement contracts had not yet achieved their Key Development Milestones.[7] This resulted in the cancelation of 751 renewable energy contracts of which 216 had Indigenous participation.

751 renewable energy contracts were cancelled, of which 216 had Indigenous participation.

On July 25th, 2018 the White Pines Wind Project Termination Act, 2018 was passed bringing the total number of cancelled renewable energy contracts to 752. This act terminated the White Pines Wind Project, a nine turbine, 18.45 MW project located in Prince Edward County, which, unlike the other cancelled projects, was partially built and close to commercial operation.

The Green Energy Repeal Act, 2018 (which repealed the Green Energy Act, 2009) was passed on December 6, 2018. The Green Energy Act, 2009 had been an impetus for most renewable electricity development in recent years. Repealing the act was largely symbolic, as no new renewable electricity procurements were active. However, the changes could make it more difficult to build renewable electricity projects in future years.

Renewable electricity provisions removed by the Green Energy Repeal Act included:

- limitations on the municipal planning authority related to the siting of renewable energy generation facilities, and
- existence of the Renewable Energy Facilitation Office which assisted proponents in navigating renewable energy project approvals.

In addition, the Green Energy Repeal Act added a new condition to the environmental approvals process for any future renewable projects, requiring them to demonstrate a need for the electricity they would produce.

The Green Energy Act had also included many provisions related to energy conservation. With the Act's repeal, most of these provisions were transferred to the Electricity Act, 1998 with a key exception being the ability to require home energy ratings and disclosure on listings prior to the sale of a home (although this section had never proclaimed). The new Ontario draft Environment Plan includes a commitment to encourage voluntary disclosure (see **Chapter 3** of this report).

The previous government had indicated plans to transition from procurement contracts for future renewable energy projects to net metering (credits on electricity bills for renewable electricity production) to support customers interested in renewable energy (particularly solar).[8] On April 20, 2018, several regulatory amendments were made to facilitate wider use of net metering, including enabling third party ownership of net-metered facilities, and supporting virtual net metering demonstration projects.[9] However, these amendments were revoked on September 25, 2018, as the current government plans to "consider any future improvements to Ontario's net metering regulatory framework in the context of its broader energy policy priorities for the province."[10]

Changes increased barriers to new renewable energy generation in Ontario.

The changes described above reduced planned renewable energy projects and increased the barriers to new renewable energy generation in Ontario. The cancelled electricity projects had been part of the previously released Long-Term Energy Plan, and would have supplied roughly 460 MW of capacity and 0.85 TWh of electricity per year. The ECO has previously shown that electrification will be essential to reducing the use of fossil fuels in Ontario, and this will require new electricity supply.[11] The cancellation of renewable projects may increase Ontario's future needs for new electricity supply or conservation (the IESO predicts an electricity shortfall of about 1,400 MW in Ontario during the summer of 2023 peaking at about 3,700 MW by 2025 then leveling off at about 2,000 MW over the long term).[12]

Table A.3. Key activities related to renewable electricity in Ontario in 2018.

Activity	Date
O. Reg. 273/18 (Net Metering Regulation) amending O. Reg. 541/05 (Net Metering Regulation) was filed and was to take effect October 1, 2018.	April 20, 2018
Announcement of cancellation of 751 renewable energy contracts.	July 13, 2018
White Pines Wind Project Termination Act, 2018 is passed.	July 25, 2018
O. Reg. 273/18 (Net Metering Regulation) amending O. Reg. 541/05 (Net Metering Regulation) is revoked.	September 25, 2018
The Green Energy Repeal Act, 2018 is passed.	December 6, 2018

A.4 Carbon pricing: cap and trade start-up and shutdown

On January 1, 2017, Ontario began a cap and trade program, which put a price on greenhouse gas (GHG) emissions. The program affected Ontarian's energy choices by increasing the price of fossil fuels and providing a source of funding for investments in energy efficiency improvements or fuel switching to less GHG intensive energy sources. Details about the cap and trade program can be found in past ECO reports (Facing Climate Change and Ontario's Climate Act: From Plan to Progress).

The government began to shut down the program on July 3, 2018 and the Cap and Trade Cancellation Act, 2018 passed on October 31, 2018, which formally ended it. There are two main impacts of this decision on Ontario's energy system:

- eliminating the price on GHG emissions reduces the financial incentive to conserve fossil fuels, and
- cancelling most energy efficiency and fuel switching programs previously funded by the revenues of the program.

Now that Ontario has no provincial carbon pricing system, the federal carbon price backstop will apply instead.

Now that Ontario has no provincial carbon pricing system, the federal carbon price backstop will apply instead.[13] On January 1, 2019, large industry began participating in a federal output-based pricing system, which will add a price to GHG emissions above specified thresholds. For most other consumers, on April 1, 2019, fossil fuels will have an added fixed charge, which will be a slightly higher price than the price added by Ontario's cap and trade program when it was cancelled ($20 in 2019 compared to approximately $18 per tonne).[14]

While the federal system will preserve some financial incentive to conserve fossil fuels through carbon pricing, the use of revenues will be different. Whereas all of the proceeds from Ontario's cap and trade system were required to be used to invest in GHG mitigation programs, most of the revenues from the federal fossil fuel charge will be returned to households as a Climate Action Incentive rebate.[15] The federal government is developing a plan to use the remaining fuel charge proceeds to support the transition for small and medium businesses, municipalities, universities, colleges, schools, hospitals, non-profit organization and Indigenous communities.[16] Similarly, the federal government is developing a plan to use output-based pricing system revenues to support large industry.[17]

The cancellation of the cap and trade program removed approximately $2 billion in annual funding for GHG mitigation programs in Ontario. This significantly reduces the investment in energy efficiency or electrification efforts in the province. Some of the programs funded by cap and trade included:

- GreenON programs,
- school retrofits,
- university and college retrofits,
- Hospital Energy Efficiency Program,
- Electric Vehicle and Charging Infrastructure Incentive Program,
- Municipal GHG Challenge Fund,
- Social Housing Apartment Improvement Program,
- Ontario Municipal Commuter Cycling Program, and
- GO Transit improvements.

The Financial Accountability Officer of Ontario has reported the provincial government plans to continue funding some programs with other revenue streams.[18] However, most have been cancelled, including those in Table A.4. Additional details are available in ECO's 2018 climate change report Climate Action in Ontario: What's Next?[19]

The cancellation of cap and trade also affect potential federal funding for energy efficiency and GHG mitigation efforts. In December 2017, the federal government announced a $420 million funding commitment to support Ontario's efforts, as part of the federal Low Carbon Economy Leadership Fund. Some of this funding would be used to support the GreenON Rebates program, and for college and university building retrofits.[20,21,22] However, in November 2018, the federal government announced that, given the Ontario government's decision to cancel climate action programs, it would be exploring options to reinvest the remaining Ontario portion of the federal funds in new initiatives.[23]

Table A.4. Key activities related to carbon pricing in Ontario in 2017 and 2018.

Activity	Date
O. Reg. 143/16 (Quantification, Reporting and Verification of Greenhouse Gas Emissions Regulation) takes effect.	January 1, 2017
The first compliance period for Ontario's cap and trade program begins.	January 1, 2017
O. Reg. 46/17 (Ontario Climate Change Solutions Deployment Corporation) establishes GreenON.	February 17, 2017
GreenON begins offering numerous programs: · GreenON Installations, · GreenON Modern Wood Heating Pilots, · GreenON Rebates, · GreenON Social Housing, · GreenON Small and Medium Businesses, · Food Manufacturing and Covered Agriculture, · GreenON Challenge, and · GreenON Industries.	2017-2018
Ontario's first cap and trade auction raises $472 million.[24]	March 22, 2017
The Government of Canada releases "Technical Paper on the Federal Carbon Pricing Backstop."[25]	May 18, 2017
Ontario signs an agreement to integrate and harmonize cap and trade programs with Quebec and California, effective January 1, 2018.	September 22, 2017
Government of Canada announces $420 million in funding for Ontario from the Low Carbon Economy Fund.	December 15, 2017
O. Reg. 539/17 (Ontario Offset Credits) made under the Climate Change Mitigation and Low-carbon Economy Act, 2016 takes effect.	January 1, 2018
Amendments to the cap and trade program and reporting regulations, new service of documents regulation, and administrative penalties regulation take effect.	January 1, 2018
The Government of Canada releases "Regulatory Framework for the Output-Based Pricing System" and the draft legislative proposals to implement the federal carbon pricing system.[26]	January 15, 2018
Ontario's last Cap and Trade auction raises $472 million.[27] The cap and trade program raised $2.9 billion in total across 6 auctions.[28]	May 15, 2018
The cancellation of GreenON programs is announced.	June 19, 2018
The federal Greenhouse Gas Pollution Pricing Act is enacted.	June 21, 2018

O. Reg. 386/18 (Prohibition Against the Purchase, Sale and Other Dealings with Emission Allowances and Credits) is passed revoking O. Reg. 144/16 (The Cap and Trade Program).	July 3, 2018
Ontario ends the Electric and Hydrogen Vehicle and Charging Incentive Programs.	August 31, 2018
Ontario misses deadline to provide federal government with carbon pricing plan.	September 1, 2018
The Government of Canada announces the federal carbon pricing backstop will apply in Ontario.[29]	October 23, 2018
The Cap and Trade Cancellation Act, 2018 is passed, revoking the Climate Change Mitigation and Low-carbon Economy Act, 2016.	October 31, 2018
The Government of Canada publish numerous instruments in order for the output-based pricing system to take effect in Ontario starting on January 1, 2019.[30]	October 31, 2018
The Government of Canada announces that the previous $420 million in funding for Ontario from the Low Carbon Economy Fund will be reinvested in other climate change initiatives as a result of Ontario's cancellation of climate action programs.	November 8, 2018
Federal output-based pricing system begins in Ontario.	January 1, 2019

The plan proposes to meet a 60% less ambitious GHG target.

A.4.1 New draft provincial Environment Plan

The Ontario government released a new draft Environment Plan on November 29, 2018. The plan signals general directions for where the province sees Ontario's environmental future. The plan proposes to meet a significantly less ambitious GHG target than the previously legislated targets, and does not include carbon pricing as an emissions reduction tool (except for large emitters). The new plan is 60% less ambitious since it only targets 18 Mt CO_2e of reductions between 2018 and 2030 compared to the previous plan's target of reductions of 47 Mt CO_2e over this period.[31] Additionally, there is no 2050 emissions reduction target. A few energy-related highlights in the plan include:

- Reviewing the energy efficiency provisions in the Building Code,
- Implementing an "emissions performance standard" for large emitters which is similar to the federal carbon pricing scheme for large emitters,
- Launching a taxpayer-funded emissions reduction fund that could potentially be used to fund energy efficiency measures,
- Working with the OEB and natural gas utilities to increase the cost-effective conservation of natural gas,
- Increasing the renewable content in gasoline from 5% to 15% (a planned increase to 10% in 2020 is already in place), and
- Requiring natural gas utilities to implement a voluntary renewable natural gas option for customers.

A.5 Merger of Union Gas and Enbridge Gas Distribution and natural gas system expansion

Union Gas and Enbridge Gas Distribution applied to the OEB for amalgamation on November 2, 2017 and their application was approved on August 30, 2018.[32] The new single entity will have approximately 3.6 million customers and service 99.8% of natural gas customers overseen by the OEB (which does not include natural gas customers in Kitchener and Kingston). The OEB will still set rates for the single entity. For now, the distributors continue to operate as separate entities, and offer separate services, including similar but not identical sets of conservation programs, to their customers.

The number of gas utility customers will increase, due to continued customer growth in areas already served by the utilities, but also because the Ontario government took steps to expand natural gas utility service to more parts of Ontario, with this expansion to be subsidized by existing gas customers. On November 17, 2016, the OEB decided that the cost of expanding infrastructure to new communities could be recovered through higher rates for those communities (if they were willing to pay) but not through subsidization from existing natural gas customers.[33] However, these higher rates could be complemented by grants from Ontario's Natural Gas Infrastructure Program.[34] This model enabled utilities to make an economic case (and receive approval from the OEB) for several system expansions (Fenelon Falls,[35] Scugog Island,[36] southern Bruce Peninsula,[37] and several additional communities in southwestern Ontario),[38] all of which relied on some level of grant funding. In total, roughly 11,000 new customers could have been connected through these grant-funded projects.[39] Interestingly, the successful applicant for one of the approved expansions (southern Bruce) was a new entrant (EPCOR Natural Gas Limited), instead of Union Gas or Enbridge. EPCOR also purchased the one other OEB-regulated gas distributor in Ontario, NRG, which serves a small number of customers in southwestern Ontario.

The Ontario government took steps to expand natural gas utility service to more parts of Ontario, with this expansion to be subsidized by existing gas customers.

Ontario's Bill 32, Access to Natural Gas Act, 2018 which received royal assent on December 6, 2018, changed direction. Bill 32 amended the Ontario Energy Board Act, 1998 to allow some costs of expansion to be recovered from other gas customers, but the government pulled grant funding for previously approved projects (three projects for which transfer payment agreements were signed will proceed – Fenelon Falls, Moraviantown First Nation, and Nipigon LNG).[40] It appears that the government's goal is for the new model to facilitate natural gas system expansion to more unserved customers, but how it will affect the previously approved system expansions is uncertain.

The approach of subsidizing natural gas system expansion may lock in an increase in fossil fuel use. Alternatives (such as increased energy conservation and energy supply from electric heat pumps) could have potentially achieved the government's objective of reducing energy costs for these Ontarians, but with a lower environmental impact.

Table A.5. Key activities related to natural gas mergers and system expansions in Ontario in 2016, 2017 and 2018.

Activity	Date
OEB issues decision allowing higher rates for communities newly served by natural gas, and denies subsidies from existing gas customers.	November 17, 2016
OEB approves purchase of NRG by EPCOR Natural Gas Limited.	August 3, 2017
OEB approves Union Gas expansion to several communities in southwestern Ontario.	August 10, 2017
Enbridge Gas Distribution and Union Gas file for amalgamation.	November 2, 2017
OEB approves Enbridge's expansion to Fenelon Falls.	March 1, 2018
OEB approves EPCOR Southern Bruce Inc's application to enter into franchise agreements with the Municipality of Arran-Elderslie, Municipality of Kincardine and the Township of Huron-Kinloss.	April 12, 2018
OEB approves Enbridge's expansion to Scugog Island.	May 31, 2018
OEB approves amalgamation of Enbridge Gas Distribution and Union Gas.	August 30, 2018
Bill 32, Access to Natural Gas Act, 2018 is enacted.	December 6, 2018

A.6 Electricity and gas conservation programs

Funding for electricity and gas conservation programs under the current frameworks is provided through 2020, and both program frameworks underwent a mid-term review in 2017 and 2018. The review for natural gas conservation has been completed by the OEB, with only minor changes implemented. The review for electricity conservation has also been completed, but it is unclear whether the Minister of Energy, Northern Development and Mines will implement any changes before the end of the current framework.

In advance of the mid-term review being completed, the Minister of Energy, Northern Development, and Mines issued several directives in 2017 and 2018 to make changes to the electricity conservation framework. In December 2016, the Minister had directed local distribution companies (LDCs) to revise their conservation plans by May 2017 to include all province-wide conservation programs. Where an LDC is not making a province-wide conservation program available, the IESO shall deliver the program in that LDC's licensed service area. In August of 2017, the IESO was directed to centrally deliver the Home Assistance (Low Income) Program, taking this program over from LDCs. The IESO was also directed in August 2017 to partner with GreenON to deliver GHG reduction programs for homes and businesses while ensuring there was no duplication with existing conservation programs.

After the 2017 Long-Term Energy Plan was released, the Minister issued a Directive amending the definition of conservation, now allowing in front of the meter activities. For example, improvements to distribution infrastructure to reduce line losses can be used by LDCs to reduce their electricity consumption to be counted towards their conservation targets. The Directive also stated that gas-fired combined heat and power programs would not be eligible to apply as a conservation measure after July 1, 2018.

Beyond 2020, funding for natural gas conservation programs may increase.

Beyond 2020, funding for natural gas conservation programs may increase, based on the new provincial draft Environment Plan (discussed previously). The future of electricity conservation currently remains uncertain as the Ministry of Energy, Northern Development and Mines has indicated that many of the recommendations arising from the electricity mid-term review may be out of date, given current government priorities.[41] The government's recent draft Environment Plan also does not include any electricity conservation initiatives to meet the province's climate goals.

A new achievable potential study was initiated in 2018 that will help assess the post-2020 conservation potential for both natural gas and electricity conservation programs, which will inform future conservation targets and budgets. The current government has also signaled a potential policy change of shifting some funding for conservation programs from the rate base to the tax base.

Some of these developments are covered in more detail in **Chapter 2** of this report, and specific program results from 2016 and 2017 are provided in **Appendix C** for electricity conservation, and **Appendix D** for natural gas conservation.

Table A.6. Key activities related to electricity and natural gas conservation programs in Ontario in 2017 and 2018.

Activity	Date
OEB initiates the natural gas conservation mid-term review.	June 20, 2017
The Minister of Energy, Northern Development and Mines issues a Directive to IESO to partner with GreenON to deliver GHG reduction programs for homes and businesses, and to deliver the Home Assistance Program.	August 7, 2017
The Ministry of Energy, Northern Development and Mines publishes the 2017 Long-Term Energy Plan.	October 26, 2017
The Minister of Energy, Northern Development and Mines issues a Directive to IESO amending the definition of conservation to include improvements in the efficiency of distribution system infrastructure, and exclude behind the meter generation projects that use fossil fuels (e.g., combined heat and power projects that use natural gas).	October 26, 2017
IESO initiates the joint natural gas and electricity conservation potential study.	February 8, 2018
The Minister of Energy, Northern Development and Mines issues a Directive to IESO transferring a portion of target and budget from the Industrial Accelerator program to centrally-delivered and province-wide conservation programs, and initiating design of a centrally delivered First Nations conservation program.	February 8, 2018
The IESO publishes the electricity conservation mid-term review report.	March 29, 2018
The IESO submits electricity conservation mid-term review advice report to Minister of Energy, Northern Development and Mines.	June 1, 2018
OEB completes the natural gas conservation mid-term review.	November 29, 2018

A.7 Cleaner transportation fuels: more ethanol, less electrification

Several different policy and program initiatives were undertaken in 2017 and 2018 that affected efforts to reduce the use of petroleum-based transportation fuels (gasoline and diesel), primarily through fuel switching to cleaner energy sources. In addition, an updated Growth Plan for the Greater Golden Horseshoe was issued in May 2017, which, through its land-use planning policies, could significantly impact the kilometres driven by Ontarians, and thus the amount of transportation fuel used (further changes were proposed in January 2019). A complementary initiative to develop a transportation plan for the Greater Golden Horseshoe was launched in October 2017. Changes to the Growth Plan are discussed in detail in **Chapter 4** of this report.

On December 14, 2017, Ontario announced the Green Commercial Vehicle program. Through incentives to customers, this program aimed to increase the number of commercial low emissions vehicles (electric or natural gas powered), improve the aerodynamics of commercial vehicles, reduce commercial vehicle idling, and increase the number of electric refrigeration units. The program was cancelled on July 3, 2018 as its funding came from the cap and trade system which was also cancelled.

Ontario's Electric and Hydrogen Vehicles Incentive Program and Ontario's Electric Vehicle Charging Incentive Program were established in 2010 (then known as the Electric Vehicle Incentive Program). The programs provided rebates for the purchase of electric and hydrogen fuel cell vehicles as well as charging infrastructure. Both programs were cancelled on July 11, 2018 as part of the cancellation of Ontario's cap and trade system and related initiatives.

On April 10, 2018, O. Reg. 227/18 was enacted leading to changes in O. Reg. 535/05 (Ethanol in Gasoline) that will come into effect on January 1, 2020, in an effort to reduce GHG emissions from gasoline. These changes will require gasoline suppliers to maintain an average 10% renewable content (e.g., ethanol) in regular gasoline, beginning in 2020, and will require the renewable content to have 45% lower lifecycle greenhouse gas emissions than gasoline. The changes also revise how compliance with the minimum renewable content of gasoline requirement is calculated, moving to a method based on the GHG intensity of the blended gasoline.

In Ontario's most recent draft Environment Plan, electrification and lower-carbon transportation fuels both play a role in the government's plan to meet its 2030 emissions reduction target. Part of the 2030 target is to be reached by the uptake of low carbon vehicles, primarily electric vehicles (although no specific commitments are made), "increasing the ethanol content of gasoline to 15% as early as 2025",[42] and the federal Clean Fuel Standard (described below).

A national clean fuel standard is to be implemented in 2020.

On December 20, 2018, the Government of Canada released a Clean Fuel Standard Regulatory Design Paper for the liquid fuels stream that outlines elements of a national clean fuel standard to be implemented in 2020,[43] to come into force by 2022 for liquid fuels. The paper states that liquid fossil fuels will be required to reduce their carbon intensity by approximately 11% by 2030. The scope of the proposed Clean Fuel Standard covers all liquid fuels (including gasoline, diesel, jet fuel, kerosene, and heavy and light fuel oils), whereas Ontario's current system applies only to gasoline (through O. Reg. 535/05) and diesel (through O. Reg. 97/14). In addition, Canada's proposed standard would allow compliance through end-use fuel switching (e.g., switching from gasoline to natural gas, propane, electric, or hydrogen powered vehicles), unlike Ontario's current regulations.

Table A.7. Key activities related to conservation of transportation fuels in Ontario in 2017 and 2018.

Activity	Date
The Ministry of Municipal Affairs and Housing releases the updated Growth Plan for the Greater Golden Horseshoe.	May 18, 2017
The Ministry of Transportation launches the Greater Golden Horseshoe transportation plan.	October 24, 2017
The Ministry of the Environment, Conservation and Parks publishes "Discussion paper: Developing a modern renewable fuel standard for gasoline in Ontario".	November 29, 2017
The Ministry of Transportation announces the Green Commercial Vehicle Program.	December 14, 2017
O. Reg. 227/18 (Ethanol in Gasoline) is enacted, amending O. Reg. 535/05 (Ethanol in Gasoline).	April 10, 2018
The Ministry of Transportation cancels the Green Commercial Vehicle program.	July 3, 2018
The Ministry of Transportation cancels the Electric and Hydrogen Vehicle and Charging Incentive programs.	July 11, 2018
Government of Canada releases Clean Fuel Standard Regulatory Design Paper.	December 20, 2018

A.8 Energy data

Building on requirements already in place for energy reporting for individual buildings by the broader public sector (O. Reg. 397/11) and the provincial government, Ontario rolled out energy benchmarking and reporting for large commercial, industrial, and multi-residential private buildings in 2017 and 2018 (O. Reg. 20/17). Unlike the requirements for the public sector, the new regulation for private buildings also requires reporting of water use, and data submission through Portfolio Manager, to facilitate comparison with other buildings. The goal of the regulation is to help building owners benchmark their energy and water use, allow comparisons with similar buildings, identify ways to reduce energy and water use and costs, and measure improvement over time.

O. Reg. 20/17 (Reporting and Energy Consumption and Water Use) was made in February 2017. Reporting will be required annually, and will be phased in over three years, depending on building size and type. The first reporting deadline was July 1, 2018, for commercial and industrial buildings over 250,000 square feet. No data from these submissions have been made publicly available yet.

Ontario rolled out energy benchmarking and reporting for large commercial, industrial, and multi-residential private buildings.

Ontario also took steps to facilitate implementation of Green Button. Green Button is a common standard for energy data, which can facilitate customers' ability to make use of software tools to understand, analyze and reduce their energy use. Legislative amendments were made in December 2017 giving the government the authority to require energy utilities to provide energy data to customers in a specified format. The Ministry of Energy, Northern Development and Mines consulted on regulatory changes that would be needed to implement these requirements, but has not made a final decision on this proposal.[44]

Table A.8. Key activities related to energy data in Ontario in 2017 and 2018.

Activity	Date
O. Reg. 20/17 (Reporting on Energy Consumption and Water Use) is enacted.	February 2, 2017
Ministry of Energy, Northern Development and Mines initiates consultation on regulatory amendments to support Green Button implementation.	November 29, 2017
Amendments to Green Energy Act and Ontario Energy Board Act are made, providing authority to require energy utilities to provide customer access to their energy data in specified format.	December 14, 2017
The deadline to report energy use in 2017 for buildings of at least 250,000 square feet under O. Reg. 20/17.	July 1, 2018

Endnotes

1. Environmental Commissioner of Ontario, Climate Action in Ontario: What's Next?, Annual Greenhouse Gas Progress Report – 2018, vol 1 (Toronto: ECO, September 2018).
2. Financial Accountability Office of Ontario, Fair Hydro Plan, An Assessment of the Fiscal Impact of the Province's Fair Hydro Plan, (Toronto: Queen's Printer for Ontario, 2017) at 1.
3. Ontario Ministry of Energy, Northern Development and Mines, News Release, "Ontario Launches New Program to Help Reduce Electricity Costs" (24 October 2017), online: <news.ontario.ca/mndmf/en/2017/10/ontario-launches-new-program-to-help-reduce-electricity-costs.html>.
4. Government of Ontario, "Fall Statement 2018" (November, 15, 2018), online: <www.fin.gov.on.ca/fallstatement/2018/chapter-1a.html> under Rate Mitigation Mechanism Replacing Global Adjustment Refinancing.
5. Ontario Ministry of Energy, Ontario's Long-Term Energy Plan 2017, (Toronto: Queen's Printer for Ontario, 2017). The ECO reviews the 2017 Long-Term Energy Plan in more detail in: Environmental Commissioner of Ontario, Making Connections: Straight Talk About Electricity in Ontario, Annual Energy Conservation Report – 2018, vol 1 (Toronto: ECO, April 2018) at Q13.
6. Environmental Commissioner of Ontario, Developing the 2017 Long-Term Energy Plan, A Special Report to the Legislative Assembly of Ontario (Toronto: ECO, December 2016).
7. Directive from Ontario Minister of Energy, Northern Development, and Mines to the Independent Electricity System Operator, Re: Maximizing the Cost-Efficient Use of Electricity Resources While Continuing to Ensure Adequacy and Reliability of Ontario's Electricity System (5 July 2018).
8. Net metering is reviewed in more detail in: Environmental Commissioner of Ontario, Making Connections: Straight Talk About Electricity in Ontario, Annual Energy Conservation Report – 2018, vol 1 (Toronto: ECO, April 2018) at Q18.
9. See Environmental Registry postings #013-1913, #013-1915, #013-1916.
10. Environmental Registry Policy Decision #013-1913, Proposed Amendment of Ontario Regulation 541/05: Net Metering, or a new Regulation (To Be Determined), to be made under the Ontario Energy Board Act, 1998 (8 May 2018).
11. Environmental Commissioner of Ontario, Making Connections: Straight Talk About Electricity in Ontario, Annual Energy Conservation Report – 2018, vol 1 (Toronto: ECO, April 2018) at Q15.
12. Independent Electricity System Operator, "Update on the First Annual Technical Planning Conference" (17 October 2018) online: <www.ieso.ca/-/media/Files/IESO/Document-Library/sac/2018/sac-20181017-planning-update.pdf?la=en>, at 14.
13. As of the time of publication, there is a proposal by the Ontario Ministry of Environment, Conservation and Parks for an emissions performance standard that would retroactively apply as of January 1, 2019 if approved. See Environmental Registry Regulation Proposal #013-4551, Making polluters accountable: Industrial Emission Performance Standards (12 February 2019).
14. Government of Canada, "Pollution Pricing: Technical Briefing", (14 November 2018), online: <www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution/technical-briefing.html>.
15. Government of Canada, "Ontario and Pollution Pricing" (20 November 2018), online: <www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/ontario.html>.
16. Department of Finance Canada, "Background: Support for Small and Medium-Sized Businesses" (23 October 2018), online: <www.fin.gc.ca/n18/data/18-097_5-eng.asp>.
17. Government of Canada, "How the Price on Pollution Works for Big Industry" (11 January 2019), online: <www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/big-industry.html>.
18. Financial Accountability Office of Ontario, Cap and Trade: A Financial Review of the Decision to Cancel the Cap and Trade Program (16 October 2018), online: <www.fao-on.org/en/Blog/Publications/cap-and-trade-ending>.
19. Environmental Commissioner of Ontario, Climate Action in Ontario: What's Next?, Annual Greenhouse Gas Progress Report – 2018, vol 1 (Toronto: ECO, September 2018).
20. Environment and Climate Change Canada, News Release, "Government of Canada Announces Funding for Energy Efficiency and Climate Action in Ontario" (15 December 2017), online: <www.canada.ca/en/environment-climate-change/news/2018/11/government-of-canada-to-support-energy-efficiency-and-climate-action-in-ontario.html>.
21. Environment and Climate Change Canada, News Release, "The Governments of Canada and Ontario Announce Funding to Help People in Ontario Save Energy and Money in Their Homes and Businesses" (4 April 2018), online: <www.canada.ca/en/environment-climate-change/news/2018/04/the-governments-of-canada-and-ontario-announce-funding-to-help-people-in-ontario-save-energy-and-money-in-their-homes-and-businesses.html>.
22. Environment and Climate Change Canada, News Release, "The Government of Canada Announces Funding to Help Ontario Colleges and Universities Save Energy and Money" (5 April 2018), online: <www.canada.ca/en/environment-climate-change/news/2018/04/the-government-of-canada-announces-funding-to-help-ontario-colleges-and-universities-save-energy-and-money.html>.
23. Environment and Climate Change Canada, News Release, "Government of Canada to Support Energy Efficiency and Climate Action in Ontario" (8 November 2018), online: <www.canada.ca/en/environment-climate-change/news/2018/11/government-of-canada-to-support-energy-efficiency-and-climate-action-in-ontario.html>.
24. Ontario Ministry of the Environment, Conservation and Parks, News Release, "Ontario Announces Results of First Cap and Trade Program Auction" (April 3, 2017), online: <news.ontario.ca/ene/en/2017/04/ontario-announces-results-of-first-cap-and-trade-program-auction.html>.
25. Environment and Climate Change Canada, "Technical Paper on the Federal Carbon Pricing Backstop", (Environment and Climate Change Canada, 2018) , online: <www.canada.ca/en/services/environment/weather/climatechange/technical-paper-federal-carbon-pricing-backstop.html>.
26. Environment and Climate Change Canada, News Release, "Government of Canada Releases Further Details on Federal Carbon-Pollution Pricing System" (15 January 2018), online: <www.canada.ca/en/environment-climate-change/news/2018/01/government_of_canadareleasesfurtherdetailsonfederalcarbon-pollut.html>.

27. Ontario Ministry of the Environment, Conservation and Parks, "Past Auction Information and Results" (July 25, 2018), online: <www.ontario.ca/page/past-auction-information-and-results>.

28. Environmental Commissioner of Ontario, Climate Action in Ontario: What's Next?, Annual Greenhouse Gas Progress Report – 2018, vol 1 (Toronto: ECO, September 2018).

29. Government of Canada, News Release, "Government of Canada Fighting Climate Change with Price on Pollution" (23 October 2018), online: <pm.gc.ca/eng/news/2018/10/23/government-canada-fighting-climate-change-price-pollution>.

30. Environment and Climate Change Canada, "Notice of Intent to Make Regulations Under Part 2 of the Greenhouse Gas Pollution Pricing Act", (31 October 2018), online: <www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/notice-intent.html>.

31. Lisa DeMarco, "Ontario Energy Association Speaker's Series, Ontario's Climate Change Plan" (presentation, 11 December 2018) slide 3, online: <documentcloud.adobe.com/link/track?uri=urn%3Aaaid%3Ascds%3AUS%3A18845028-a5c3-43e7-a95a-96ee9dc8dcb9>. Under the assumptions, the previous target would have been 114 Mt CO_2e in 2030, whereas the new target is 143 CO_2e in 2030 (Ontario emissions in 2016 were 161 Mt CO_2e, and emissions in 2018 are expected to also be around 161 Mt CO_2e).

32. Union Gas Limited and Enbridge Gas Distribution Inc., Application for Amalgamation and Rate-Setting Mechanism, Ontario Energy Board EB-2017-0306 and EB-2017-0307, (Toronto, August 30, 2018), online: <www.oeb.ca/sites/default/files/Dec-Order-EGD-Union-Amalgamation-20180830.pdf>.

33. Ontario Energy Board Generic Proceeding on Community Expansion, Ontario Energy Board EB-2016-0004, (Toronto. 17 November 2016), online: <www.rds.oeb.ca/HPECMWebDrawer/Record/552883/File/document>.

34. Ontario Ministry of Infrastructure, "Ontario's Natural Gas Grant Program: 11 New Projects", (Toronto, MOI, 3 April 2018), online: <news.ontario.ca/moi/en/2018/04/ontarios-natural-gas-grant-program-11-new-projects.html>.

35. Enbridge Gas Distribution Inc., Application for Approval to Construct Natural Gas Pipelines to Serve the Community of Fenelon Falls and Charge a System Expansion Surcharge to All New Customers in the Community of Fenelon Falls, Application for a Certificate of Public Convenience and Necessity for the City of Kawartha Lakes, Application to Charge a System Expansion Surcharge to all New Customers of Future Community Expansion Projects, Ontario Energy Board EB 2017-0147 (Toronto: 1 March 2018), online: <www.rds.oeb.ca/HPECMWebDrawer/Record/600928/File/document>.

36. Enbridge Gas Distribution Inc., Scugog Island Community Expansion Project, Ontario Energy Board EB-2017-0261, online: <www.rds.oeb.ca/HPECMWebDrawer/Record/610116/File/document>.

37. South Bruce Expansion Applications, Ontario Energy Board EB-2016-0137, EB-2016-0138, and EB-2016-0139, online: <www.rds.oeb.ca/HPECMWebDrawer/Record/605070/File/document>.

38. Union Gas Limited, Community Expansion Application, Ontario Energy Board EB-2015-0179, online <www.rds.oeb.ca/HPECMWebDrawer/Record/580124/File/document>.

39. Ontario Ministry of Infrastructure, "Ontario's Natural Gas Grant Program: 11 New Projects", (Toronto, MOI, 3 April 2018), online: <https://news.ontario.ca/moi/en/2018/04/ontarios-natural-gas-grant-program-11-new-projects.html>.

40. Ontario Ministry of Infrastructure, information provided in response to ECO inquiry (1 February 2019).

41. Ontario Ministry of Energy, Northern Development and Mines, information provided in response to ECO inquiry (15 January 2019).

42. Ontario Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations, A Made-in-Ontario Environment Plan, (Toronto, MECP, 2018), online: <prod-environmental-registry.s3.amazonaws.com/2018-11/EnvironmentPlan.pdf> at 23.

43. Environment and Climate Change Canada, Clean Fuel Standard Regulatory Design Paper, (Ottawa, Minister of Environment and Climate Change, 2018).

44. Environmental Registry Regulation Proposal #013-1874, Regulatory Proposal for Province-Wide Implementation of Green Button (29 November 2017).

Appendix B:
Progress on conservation targets

Abstract

This chapter describes Ontario's progress towards meeting government-established targets for reducing the use or making more efficient use of electricity, natural gas, propane, oil and transportation fuels. These targets have been established either through a formal government policy or via a Ministerial Directive to an organization or an agency. The latest date for which results are available varies by target, and is specified for each target.

Due to the change in provincial government in June 2018, some of these targets are under review and may be revised.

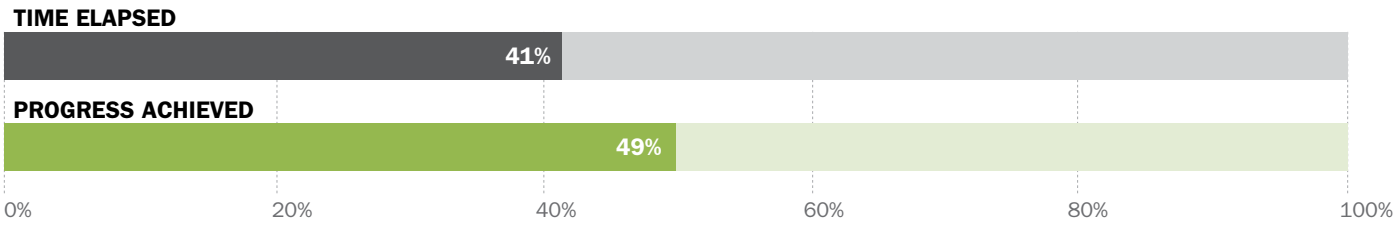
Contents

B.1 Electricity conservation targets

Results in 2016 and 2017 from electricity conservation programs are covered in more detail in **Appendix C** of this report.

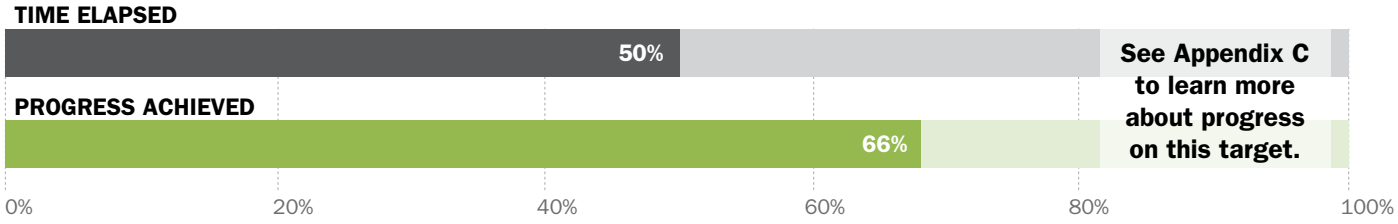
B.1.1 Long-Term Energy Plan target

Target	30 TWh reduction in annual electricity consumption by 2032 due to conservation efforts from 2005 onwards
Source	Long-Term Energy Plans (2013, 2017)
Responsibility	Ministry of Energy, Northern Development and Mines; Independent Electricity System Operator
Results	14.7 TWh of savings projected to persist until 2032
Comment	The 2032 target represents approximately 20% of Ontario's current annual electricity consumption. As of December 31, 2017, 15.7 TWh of electricity savings have been achieved but not all will persist until 2032. These savings are attributable to utility-run electricity conservation programs, codes and standards, pricing policies, and other programs.
Time elapsed	41%
Progress achieved (as of December 31, 2017)	49%



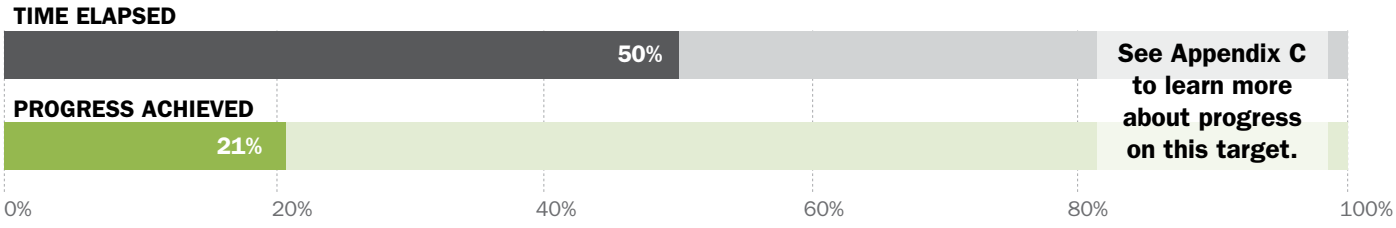
B.1.2 Electricity conservation programs for distribution-connected customers

Target	7.4 TWh (previously 7.0 TWh)[1] of persistent annual electricity savings in 2020 from conservation programs for distribution-connected customers that operate between January 1, 2015 and December 31, 2020
Source	Directives from the Minister of Energy to the Independent Electricity System Operator, March 31, 2014, February 8, 2018
Responsibility	Local distribution companies; Independent Electricity System Operator
Results	4.9 TWh of persistent energy savings to 2020
Comment	The 2020 target represents approximately 5% of Ontario's current annual electricity consumption. This target is part of the government's overall conservation target of 30.0 TWh by 2032, as set out in the 2017 Long-Term Energy Plan.
Time elapsed	50%
Progress achieved (as of December 31, 2017)	66%



B.1.3 Electricity conservation programs for transmission-connected customers

Target	1.3 TWh (previously 1.7 TWh)[2] of persistent annual electricity savings in 2020 from the Independent Electricity System Operator's Industrial Accelerator Program for transmission-connected customers, from activities between January 1, 2015 and December 31, 2020
Source	Directives from the Minister of Energy to the Independent Electricity System Operator, March 31, 2014, February 8, 2018
Responsibility	Independent Electricity System Operator
Results	268 GWh of persistent energy savings to 2020
Comment	This target is part of the government's overall conservation target of 30 TWh by 2032, as set out in the 2017 Long-Term Energy Plan
Time elapsed	50%
Progress achieved (as of December 31, 2017)	21%



B.1.4 Electricity demand response

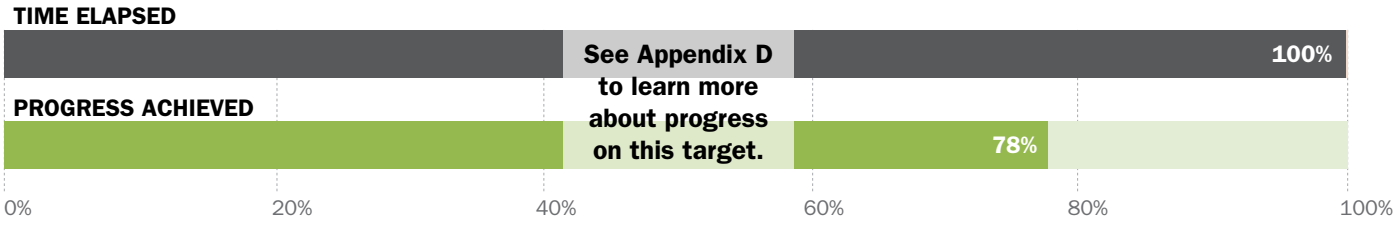
Target	10% of 2025 peak demand (roughly 2,400 MW) was previously targeted
Source	Long-Term Energy Plans (2013, 2017)
Responsibility	Ministry of Energy, Northern Development and Mines; Independent Electricity System Operator
Results	No longer applies
Comment	The target was originally set in the 2013 Long-Term Energy Plan. However, the 2017 Long-Term Energy Plan stated that "demand response capacity realized each year will depend on system needs and the competitiveness of demand response with other resources." The Independent Electricity System Operator has confirmed that this means the original 10% target is no longer in effect.[3]
Time elapsed	No longer applies
Progress achieved	No longer applies

B.2 Natural gas conservation targets

Ontario's two largest natural gas companies, Enbridge Gas Distribution and Union Gas, deliver demand-side management (DSM) programs under the 2015-2020 DSM Framework, which is overseen by the Ontario Energy Board (OEB). Unlike the electricity conservation framework, natural gas conservation targets are adjusted on an annual basis. The interpretation of the 2016 targets is still under review. A breakdown and analysis of 2016 conservation program targets and results is available in **Appendix D** of this report. While these are not government-established targets, they are approved by the OEB, in a framework developed in response to a Ministerial Directive.

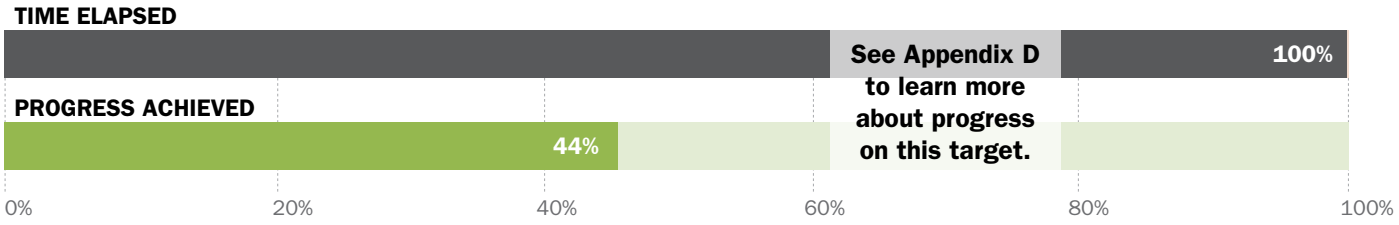
B.2.1 Enbridge Gas conservation target

Target	1.080 billion m^3 lifetime natural gas savings from 2016 programs (319 million m^3 from small-volume customers, 665 million m^3 from large-volume customers and 97 million m^3 from low-income customers)[4]
Source	Enbridge 2015-2020 Demand-Side Management Plan (as modified by OEB decision)
Responsibility	Enbridge Gas Distribution
Results	0.837 billion m^3 net lifetime natural gas savings (395 million m^3 from small-volume customers, 329 million m^3 from large-volume customers and 114 million m^3 from low-income customers)
Time elapsed	100%
Progress achieved (as of December 31, 2016)	78%



B.2.2 Union Gas conservation target

Target	2.162 billion m^3 lifetime natural gas savings from 2016 programs (1,214 million m^3 from small-volume customers, 57 million m^3 from large-volume customers and 891 million m^3 from low-income customers)[5]
Source	Union 2015-2020 Demand-Side Management Plan (as modified by OEB decision)
Responsibility	Union Gas
Results	0.959 billion m^3 net lifetime natural gas savings (815 million m^3 from small-volume customers, 65 million m^3 from large-volume customers and 80 million m^3 from low-income customers)
Time elapsed	100%
Progress achieved (as of December 31, 2016)	44%

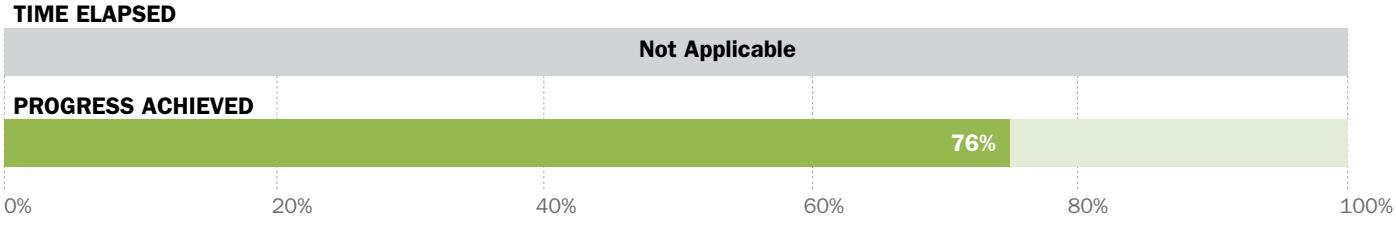


B.3 Transportation fuel conservation targets

Transportation fuel targets include renewable fuel standards for gasoline and targets associated with switching to non-petroleum fueled vehicles, such as electric vehicles. Since such targets reduce the use of fossil fuels and improve energy efficiency, these fall under the ECO's reporting mandate. Given the recent change in provincial government, some of these targets may be reviewed or altered by the current government.

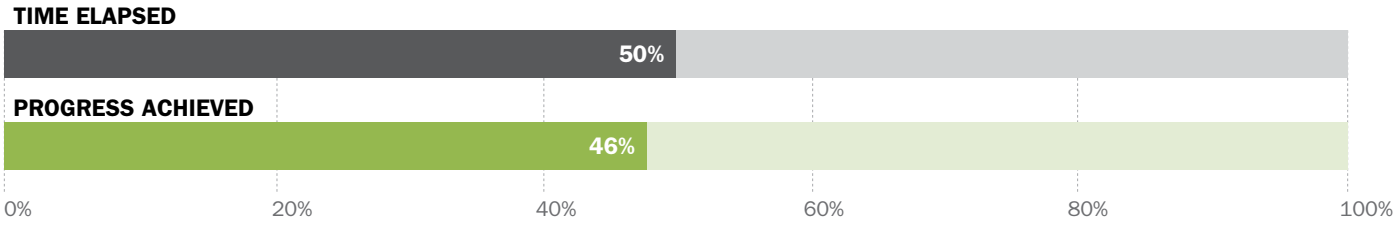
B.3.1 Renewable content in gasoline

Target	10% renewable content in gasoline required by 2020
Source	O. Reg. 535/05 (Ethanol in Gasoline)
Responsibility	Ministry of Environment, Conservation and Parks (MECP)
Result	Ethanol levels in gasoline in 2016 were roughly 7.6%, which is higher than the current minimum requirement of 5%[6]
Comment	MECP amended O. Reg. 535/05 (Ethanol in Gasoline) in spring 2018. These changes will require gasoline suppliers to maintain an average 10% renewable content (e.g., ethanol) in regular-grade gasoline, beginning in 2020, and will require the renewable content to have 45% lower lifecycle greenhouse gas emissions than gasoline.[7] MECP estimates that once in effect, these changes would achieve a 4.1% reduction in GHG emissions relative to gasoline. MECP estimates current renewable content has 42% lower GHG emissions than gasoline, and reduces overall blended fuel GHG emissions by 3.2%.[8] The government is currently proposing to amend O. Reg. 535/05 to further increase the renewable content in gasoline to 15% as early as 2025.[9]
Time elapsed	N/A
Progress achieved (as of December 31, 2016)	76%



B.3.2 Increasing electric and hydrogen vehicle sales

Target	5% of passenger vehicle sales to be electric or hydrogen in 2020 was previously targeted
Source	Climate Change Action Plan (2016)
Responsibilities	Ministry of Transportation: Electric vehicle and charger incentives Ministry of Energy, Northern Development and Mines: Electric vehicle overnight charging incentives Ministry of Environment, Conservation and Parks: vehicle replacement incentives Ministry of Finance: Eliminating HST on battery electric vehicles Ministry of Infrastructure: Electric vehicle charging at government facilities Ministry of Municipal Affairs and Housing: Building Code amendments
Results	Electric and hydrogen vehicles accounted for 2.3% (15,307)[10] of vehicle sales[11] in the first three quarters of 2018.
Comment	The Ministry of Transportation does not track new vehicle sales so results are not official. The Ministry does track vehicle registration. As of January 31, 2019, 32,481 electric vehicles and five hydrogen vehicles were registered and active on the road, and 346 public electric vehicle charging stations have been installed in the province.[12] The financial incentives supporting this target have been cancelled, so electric and hydrogen vehicles may not maintain this share of new vehicle sales. The draft Environment Plan identifies increased use of electric vehicles as an important part of the government's plan to reach its 2030 GHG reduction targets, but does not include a specific sales target.[13] It also does not include specific policies to promote adoption of electric vehicles.
Time elapsed	50%
Progress achieved (as of December 31, 2017)	46%



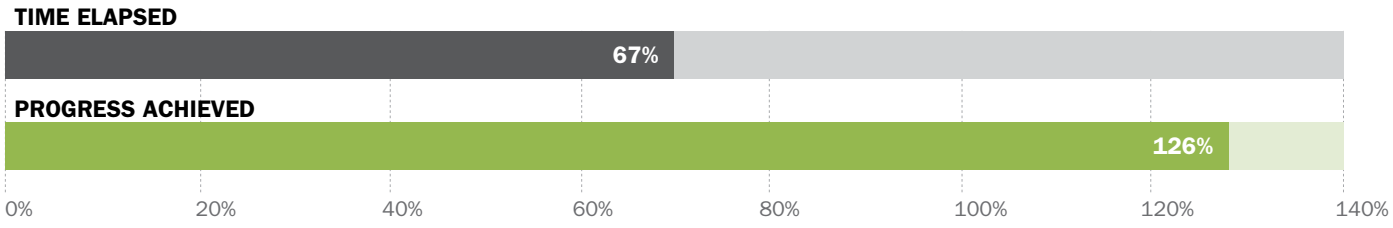
B.4 Other fuels conservation targets

The Ministry of Energy's 2017 Long-Term Energy Plan discussion guide, Planning Ontario's Energy Future, posed the question "should Ontario set conservation targets for other fuel types, such as oil and propane."[14] The ECO had urged the government to do just that in two recent reports.[15] However, the final 2017 Long-Term Energy Plan did not set conservation targets for other fuels.

B.5 Ontario Public Service energy use reduction targets

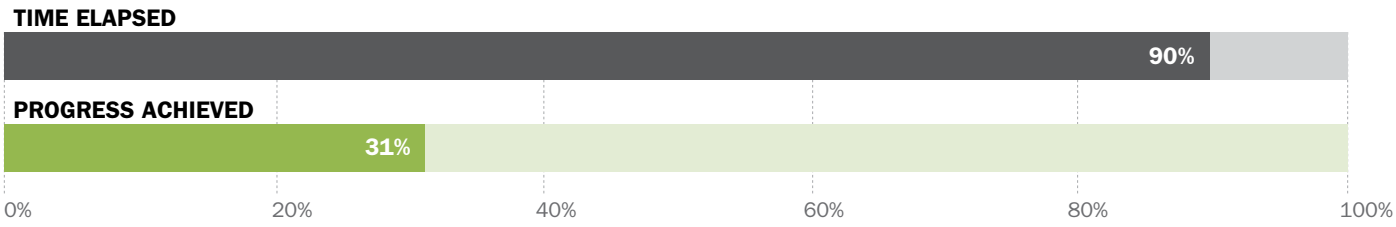
B.5.1 Ontario Public Service greenhouse gas reduction target

Target	27% reduction in greenhouse gas emissions from the Ontario Public Service by 2020/2021 from 2006 baseline
Source	Ontario Green Transformation Strategy (2009)
Responsibility	Ministry of Environment, Conservation and Parks; Ministry of Consumer and Government Services
Results	34% reduction (93.9 kt CO_2e) from the 2006 baseline[16]: · 30% (29.8 kt CO_2e) reduction in vehicle fuel consumption · 9% (0.5 kt CO_2e) increase in air travel · 37% (64.6 kt CO_2e) reduction in building energy use
Comment	This target is under review as the government has committed to developing a Climate Change Governance Framework,[17] and will consider the role that Ontario Public Service greenhouse gas targets in this process.[18]
Time elapsed	67%
Progress achieved (as of March 31, 2017)	126%



B.5.2 Ontario Public Sector electric vehicle target

Target	500 electric vehicles added to the Ontario Public Service fleet by 2020
Source	Ontario Green Transformation Strategy (2009)
Responsibility	Ministry of Environment, Conservation and Parks; Ministry of Consumer and Government Services
Results	157 electric vehicles (22 battery electric vehicles and 135 plug-in hybrid electric vehicles), up from 90 electric vehicles in 2018[19]
Comment	The Ontario Public Service fleet also includes 1,318 hybrid vehicles that are not plug-in, these are not counted towards the target results.
Time elapsed	90%
Progress achieved (as of January 2019)	31%



Endnotes

1. This target was amended through a Ministerial directive in February 2018. The target for distribution-connected customers was increased by 0.4 TWh, and the target for transmission-connected customers was decreased by 0.4 TWh, preserving the combined target of 8.7 TWh.

2. This target was amended through a Ministerial directive in February 2018. The target for distribution-connected customers was increased by 0.4 TWh, and the target for transmission-connected customers was decreased by 0.4 TWh, preserving the combined target of 8.7 TWh.

3. Independent Electricity System Operator, information provided to the ECO (January 2019)

4. Ontario Energy Board, 2016 Natural Gas Demand Side Management Annual Verification by DNV-GL (Toronto: OEB, 30 October, 2018) online: <https://www.oeb.ca/sites/default/files/OEB-2016-Natural-Gas-DSM-Annual-Verification-Report-20181030-2.pdf>, at 18, 19. Enbridge has argued that the 2016 targets should be updated to reflect changes arising from the 2015 evaluation. If Enbridge's interpretation is accepted by the Ontario Energy Board, the updated 2016 target would be 727.8 million m^3 (332.2 million m^3 from resource acquisition programs for large-volume customers, 298.9 million m^3 from resource acquisition programs for small-volume customers, and 96.7 million m^3 from low-income programs. Enbridge, 2016 Demand Side Management Annual Report (Enbridge, 17 November 2018) online: <http://www.rds.oeb.ca/HPECMWebDrawer/Record/628426/File/document>, at 28, 75.

5. Ontario Energy Board, 2016 Natural Gas Demand Side Management Annual Verification by DNV-GL (Toronto: OEB, 30 October, 2018) online: <https://www.oeb.ca/sites/default/files/OEB-2016-Natural-Gas-DSM-Annual-Verification-Report-20181030-2.pdf>, at 26-28. Union has argued that the 2016 targets should be updated to reflect changes arising from the 2015 evaluation. If Union's interpretation is accepted by the Ontario Energy Board, the updated 2016 target would be 2,070.3 million m^3 (1,120.0 million m^3 from resource acquisition programs, 890.9 million m^3 from programs for large-volume customers, and 59.2 million m^3 from low-income programs. Union Gas, 2016 Demand Side Management Final Annual Report (Union Gas, 30 November 2018) online: <http://www.rds.oeb.ca/HPECMWebDrawer/Record/627745/File/document>, at 34, 70, 89.

6. Ministry of Environment, Conservation and Parks, information provided to the ECO (January 2019)

7. Environmental Registry Regulation Decision #013-1929, Low Carbon Transportation Fuels in Ontario: Amendments to Ethanol in Gasoline (O. Reg. 535/05) and Greener Diesel – Renewable Fuel Content Requirements for Petroleum Diesel Fuel (O. Reg. 97/14) Regulations (12 April 2018).

8. Ministry of Environment, Conservation and Parks, information provided to the ECO (January 2019)

9. Environmental Registry Regulation Proposal #013-4598, Increasing renewable content in fuels (12 February 2019).

10. Fleetcarma, "Electric Vehicle Sales Update Q3 2018, Canada" (November 6, 2018) online: <https://www.fleetcarma.com/electric-vehicles-sales-update-q3-2018-canada/>. [Accessed 21 February 2019]

11. Statistics Canada, "Table 20-10-0001-01 New motor vehicle sales" (February 14, 2019) online: <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=2010000101#timeframe> .

    Vehicle sales in 2018 includes all on road vehicles. These include cars, minivans, sport-utility vehicles, light and heavy trucks, vans and buses. However, nearly all (98%) vehicles sales have been passenger vehicles in previous years (2015, 2016, 2017).

    Statistics Canada, "Table 20-10-0002-01 New motor vehicle sales, by type of vehicle" (February 14, 2019) online: <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=2010000201>.

12. Ministry of Transportation, information provided to the ECO (January 2019, February 2019). A slightly higher number (33,637) are registered but not all are plated and active. Metrolinx has recently removed 24 installed charging stations at GO Transit parking lots, although these were not part of the provincial government's public Electric Vehicle Charging program.

13. Ministry of Transportation, information provided to the ECO (January 2019).

14. Ministry of Energy, Planning Ontario's Energy Future (Toronto: MENG, 2016) at 37.

15. Environmental Commissioner of Ontario, Developing the 2017 Long-Term Energy Plan (Toronto: ECO, 6 December 2016) at 18; Environmental Commissioner of Ontario, Conservation Let's Get Serious, Annual Energy Conservation Progress Report – 2015/2016 (Toronto: ECO, 31 May 2016) at 151.

16.

Vehicle Travel	**Baseline (2006/07)**	**2014/15**	**2015/2016**	**2016/17**	**2017/18**
Fuel (million L)	41	32	30	29	29
GHG emissions (kt CO_2e)	98.3	76.5	72.0	68.5	68.4
GHG reduction from baseline	n/a	-22%	-27%	-30%	-30%
Air Travel	**Baseline (2006/07)**	**2014/15**	**2015/2016**	**2016/17**	**2017/18**
Distance (million km)	47	40	43	51	57
GHG emissions (kt CO_2e)	5.6	4.8	5.2	6.1	6.8
GHG reduction from baseline	n/a	-14%	-7%	9%	21%
Facilities	**Baseline (2006)**	**2014**	**2015**	**2016**	**2017**
GHG emissions (kt CO_2e)	173.2	124.4	118.2	108.6	Not yet available
GHG reduction from baseline	n/a	-28%	-32%	-37%	Not yet available
Total					
GHG emission (kt CO_2e)	277.2	205.7	195.4	183.2	Not yet available
GHG reduction from baseline	n/a	-26%	-30%	-34%	Not yet available

Facilities notes:

- Includes consumption from the following energy sources: electricity, natural gas, district steam, fuel oil, district hot water, propane and district chilled water.
- Baseline will change as a result of changing real estate portfolio. For guidance, the World Resource Institute standard for corporate reporting is used as guidance in making baseline adjustments.
- Current reporting year emissions are based on emission factors listed in the Ontario Public Service Guidance Document for Quantifying Projected and Actual GHG Emission Reductions prepared by Cheminfo and published on June 30, 2017, with the exception of the emission factor for steam (66.33 kg CO_2e/mmBTU) taken from the U.S. Environmental Protection Agency.
- Includes Infrastructure Ontario managed facilities, Alternative Financing Procurement facilities, and custodial ministry managed facilities (include Ministry of Community Safety and Correctional Services, Ministry of Children and Youth Services, Ministry of Transportation, Ministry of Natural Resources and Forestry and Ministry of Education).
    - Consumption differences from year to year result from:
    - Infrastructure Ontario's conservation efforts for energy target
    - Operational and program use changes
    - Alternative Financing Procurement net new consumption. The added facilities (from 2009-current) have strict energy efficiency guidelines. However, all have been built after the 2006 baseline. The consumption has only added to total inventory consumption.

17. Ontario Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations, A Made-in-Ontario Environment Plan, (Toronto, MECP, 2018) at 35.

18. Ministry of Environment, Conservation and Parks, information provided to the ECO (January 2019).

19. Ministry of Environment, Conservation and Parks, information provided to the ECO (January 2019).

Appendix C: Electricity conservation program results

Abstract

This chapter reviews the 2016 and 2017 results of electricity conservation programs and initiatives funded by electricity ratepayers. These include:

- conservation programs delivered to distribution-connected customers by local distribution companies (LDCs) and the Independent Electricity System Operator (IESO) under the Conservation First Framework (CFF)
- conservation programs delivered by the IESO to larger transmission-connected customers, and
- demand response programs and market mechanisms that curtail electricity use at times of system peak demand.

The CFF program framework has been very successful in achieving electricity savings. In 2016, LDCs achieved 1.5 terawatt-hours (TWh) of incremental electricity savings persisting to 2020, similar results to 2015. 2017 was the best performing year for the province to date, with LDCs achieving 1.8 TWh of incremental savings that will persist to the end of 2020. At the end of 2017, halfway through the six-year framework, LDCs are collectively on track to achieve the provincial target of 7.4 TWh, already having achieved 66% (4.9 TWh) of this 6-year target. If current trends continue, this target will be achieved or exceeded within the allocated budget. This will reduce provincial electricity use in 2020 by roughly 4-5% below what it would otherwise be. Performance across LDCs varies widely, with 59 of 68 LDCs on pace to meet or exceed their local target.

Programs for commercial and industrial customers were responsible for more than 60% of the province's persistent savings to date, with the Retrofit program leading the charge. Residential programs such as the Coupon/Instant Discount Program (primarily incenting efficient LED lighting) and the HVAC program (efficient air conditioning and furnaces) brought in substantial results, with the Coupon/Instant Discount Program driving an increasing number of LED sales in 2016 and 2017.

Under the CFF, conservation program innovation at the local level has flourished, with 12 local programs and 22 pilots launching in 2016 and 2017. These programs, particularly the Social Benchmarking program, the PUMPSaver Program and the PoolSaver Program are delivering an increasing share of savings.

The IESO's program for large (primarily industrial) transmission-connected customers has been less successful. This program achieved 0.28 TWh in persistent savings (21% of the current target of 1.3 TWh, which was originally a 1.7 TWh target) at the end of 2017. A portion (0.4 TWh) of the original target and budget for this program have consequently been reallocated to other IESO programs for distribution-connected customers. This budget will be used by the IESO to deliver a new pay-for-performance program and to ensure province-wide availability of key programs (particularly the program for low-income customers) in parts of the province where these programs were not being offered by LDCs.

In terms of demand response initiatives, the IESO has contracted a significant amount of demand response through its annual auction at a cost that has dropped about 40% in the last four years. To date, the capacity procured at the auction has not been called upon. However, the IESO did successfully curtail 285 megawatts of peak demand from contracted demand response resources during the September 2017 heatwave.

Conservation spending on all of these initiatives was $391 million in 2016 and $541 million in 2017, roughly 2% of the total cost of operating the electricity system. The cost-effectiveness of conservation programs, especially those delivered by the LDCs, has improved since 2015, delivering savings in 2017 at a cost of less than two cents per kWh of electricity saved. Conservation programs delivered in 2017 delivered roughly two and a half dollars in benefits for every dollar spent, primarily from avoiding the need for new electricity generation and reducing fuel and operational costs for existing electricity generators.

Contents

C.1 Introduction

Electricity conservation initiatives are funded through provincial electricity charges[1], in order to reduce long-term costs for electricity ratepayers by avoiding more expensive electricity supply alternatives. These include conservation and demand management initiatives geared towards distribution and transmission customers province-wide.

Electricity conservation initiatives reduce long-term costs for electricity ratepayers by avoiding more expensive electricity supply alternatives.

Under the Conservation First Framework (CFF), the province's local distribution companies (LDCs) deliver province-wide conservation programs to distribution-connected customers under the oversight of the Independent Electricity System Operator (IESO). There is a variety of programs for residential, commercial, institutional and industrial customers. The LDCs also have the opportunity to offer local programs and pilots to their own customers only.

The IESO directly delivers conservation programs to large transmission-connected customers and is also responsible for demand response programs and market mechanisms to reduce peak demand electricity use {as discussed in **Chapter 2** of this report, the Green Ontario Fund launched some new initiatives that overlapped to some degree with existing electricity conservation programs. However, these initiatives did not significantly affect electricity conservation results in 2017, and are not covered in this appendix}.

Collectively, these conservation initiatives undertaken in 2017 will deliver 1.9 TWh of annual electricity savings in 2020 (94.6% from CFF programs and 5.4% from the Industrial Accelerator program).[2] This is equivalent to about 1.4% of current annual electricity consumption.[3] Conservation initiatives undertaken in 2017 also delivered 1065 MW of peak demand savings in 2017 (23.3% from CFF programs, 1.1% from the Industrial Accelerator program, and 75.5% from DR initiatives)[4]. This is equivalent to about 4.8% of 2017's peak demand.[5]

This chapter reviews 2016 and 2017 results for each of these categories of conservation initiatives in turn.

C.2 Utility conservation programs

C.2.1 Conservation First Framework (CFF)

The province of Ontario saw a considerable amount of energy savings in 2016 and in 2017 under the 2015-2020 Conservation First Framework (CFF). This Framework establishes a partnership between the Independent Electricity System Operator (IESO) and Ontario's 68 LDCs[6] to design and deliver electricity conservation programs to the customers of LDCs (i.e., almost all Ontario electricity users, with the major exception of some large, primarily industrial, companies connected to the high-voltage transmission grid). The 2015-2020 Conservation First Framework (CFF) was established through the Directive issued by the Ontario Minister of Energy to the then Ontario Power Authority (OPA), now the IESO. The Directive instructed the OPA to "*coordinate, support and fund the delivery of CDM {conservation and demand management} programs through the Distributors to achieve a total of 7 TWh reductions in electricity consumption between January 1 2015 and December 21, 2020…*".[7]

Ontario saw considerable of energy savings in 2016 and in 2017 under the 2015-2020 Conservation First Framework.

Table C.1 lists the key elements of the 2015-2020 Conservation First Framework, including the requirement that conservation projects completed in any given year must persist (still be delivering energy savings) until at least the end of the framework (2020) to be counted towards the final target. The list also highlights that the IESO has to complete a Mid-Term Review by June 1, 2018 to report on the province's progress to date. The Mid-Term Review is discussed in **Chapter 2**.

Table C.1. Key Elements of the 2015-2020 Conservation First Framework.[8]

Key framework elements	2015-2020 Conservation First Framework
Duration	6 years (2015 is a transition year from the 2011-2014 Conservation and Demand Management framework)
Oversight	Independent Electricity System Operator
Target	Energy savings: 7400 GWH (7.4 TWH) of **persistent** energy savings in 2020[9] Peak demand: Not an LDC target anymore
Energy savings calculation	Persistent Savings: savings occurring in 2020, from measures installed at any time between 2015 and 2020.
Budget	$1.8 billion for LDCs +$0.4 billion for IESO programs and central services[10]
Funding to LDCs	LDCs have one budget for 6 years and can allocate funding between program portfolios as needed as long as LDCs remain cost-effective[11] and offers programs to all customer segments
CDM license requirement	March 31, 2014 Directive stated that the LDC shall "make CDM programs available to customers in its licensed service area and shall, as far as is appropriate and reasonable having regard to the composition of the Distributor's customer base, do so in relation to each customer segment in its service area"[12] However, a subsequent Directive issued in December 2016 mandated LDCs to revise their CDM plans "outlining how they will make all approved province-wide CDM programs available in their licensed service areas" and "where a Distributor with eligible program participants is not making an approved Province-Wide Distributor CDM Program (s) available to eligible program participants in its licensed service area, the IESQ shall deliver the Province-Wide Distributor CDM Program (s) in that Distributor's licensed service area."[13]
Target allocation	Energy target for each LDC based on estimate of achievable conservation potential in each region and LDC territory[14]
Program composition	LDCs can offer a mix of IESO-approved provincial, regional and local programs, including joint programs with gas companies.[15] Programs must be approved by the IESO and the "duplication test" rules have been amended to encourage collaboration and local/regional program applications
Incentives	Under a full-cost recovery model, LDCs are eligible for a Mid-Term Incentive, an Achieving Target Incentive and an Exceeding Target Incentive, all of which increase if the LDC is part of a joint plan with other LDCs. Also eligible for a Cost-Efficiency Incentive. LDC can also opt for a pay-for-performance model, where incentives are based on program performance.[16]

Underperformance	IESO will track performance annually and take remedial steps of various degrees to help improve the LDC's underperformance. If performance and cost-effectiveness falls below a certain threshold, the LDC will face financial remedies[17]
Mid-Term Review	Mid-term report completed in May of 2018, has been submitted to the Minister of Energy and is currently awaiting response

Source: 2015-2020 IESO-LDC Energy Conservation Agreement (2014), various Directives and Directions from the Ontario Minister of Energy to the IESO, OPA and OEB from 2014 to present.

2016 was the first full year of the 2015-2020 Conservation First Framework.

C.2.2 Province-wide results

2016 was the first full year of the 2015-2020 Conservation First Framework, since 2015 was considered a transition year between the two conservation frameworks. Given that most LDCs were completing 2011-2014 CDM projects in 2015, 2/3 of the province's LDCs launched CFF on January 1, 2016. (However, results from 2015 conservation programs still contribute to the 2020 target).

In 2016, net energy savings persisting to 2020 from distribution-connected conservation programs was 1512 GWh, which represents 22% of the province's 7 TWh (7000 GWh) six-year target.[18] Savings in 2015 were 1559 GWh (Both 2015 and 2016 results reflect late reporting and true-ups that were captured during subsequent reporting stages, which increased results by roughly 30%).[19] So, the first full year of the new framework delivered roughly the same amount of savings as the previous year.

2017 was a step forward and was the strongest year of performance for the CFF, in terms of delivering persistent energy savings. The province's LDCs achieved persistent net energy savings of 1793 GWh (1.8 TWh). Savings may end up being even higher if the previous pattern of significant true-ups continues for the 2017 results. In February 2018, the 7 TWh target was amended to 7.4 TWh by a Ministerial Directive that moved 0.4 TWh of target from the Industrial Accelerator Program (IAP, discussed later in the chapter) to the CFF.[20] The IESO has decided to allocate the entire transferred budget ($220 million) and target to centrally-delivered programs only, and has kept the LDC targets and budgets the same.[21] In other words, the total target for conservation programs for distribution-connected customers is now 7.4 TWh, instead of 7 TWh, but targets for individual LDCs will not increase and are still based on the original 7 TWh target. Combining results from 2015-2017, at the halfway point of the six-year framework, the province has achieved 4.9 TWh of savings that will persist until 2020. This is 69% of the original 7 TWh target, and 66% of the amended 7.4 TWh target.[22] Ontario is well on pace to meet or exceed the province-wide target, on time and on budget.

Ontario is well on pace to meet or exceed the province-wide target, on time and on budget.

Figure C.1 presents the incremental first year net energy savings every year since 2011, i.e., it shows the amount of new net savings that are added on by the conservation programs every year. Incremental net energy savings are slightly higher than persistent numbers since not all incremental savings persist

to the end of the framework and are therefore not counted in the final targets. Figure C.1 shows that 2016 saw a dip in incremental savings from 2015 but then ramped up again in 2017. This can be explained by the fact that all the 2011-2014 CDM Framework programs that were completed in 2015 bolstered the incremental results of that year. With 2016 being the first full year of the CFF, LDCs took some time to ramp up program offerings that would have contributed to lower new savings achieved that year. By 2017, LDCs were fully engaged in CFF, and incremental savings increased by almost 20%. Looked at over the longer period, electricity savings from utility programs have increased dramatically, more than tripling since the early 2010s.

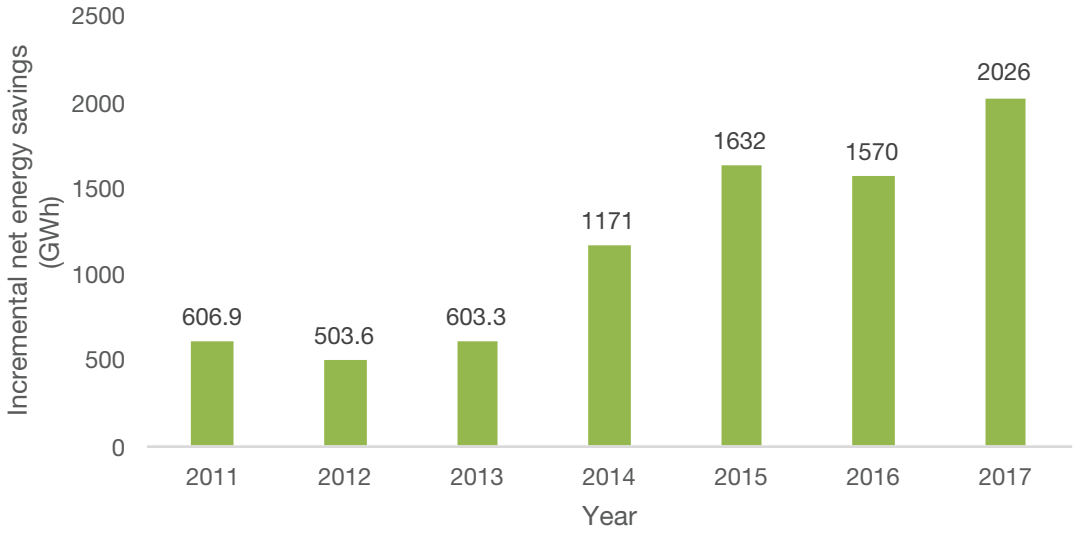


Figure C.1. First year incremental energy savings from new conservation program activity for distribution connected-customers.

Note: 2015 and 2016 incremental energy savings were updated based on true-ups in the 2017 verified results. Not all the first year savings from 2015 to 2017 shown here will be counted towards the final 2020 target as not all incremental savings will persist to the end of the framework. Therefore, incremental savings are slightly higher than persistent savings.

Source: Independent Electricity System Operator, information provided in response to ECO inquiry (15 January 2019); Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province-wide Progress"; Independent Electricity System Operator, 2016 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2017) at Tab "Province-wide Progress".

Most conservation initiatives also contribute to peak demand reductions.

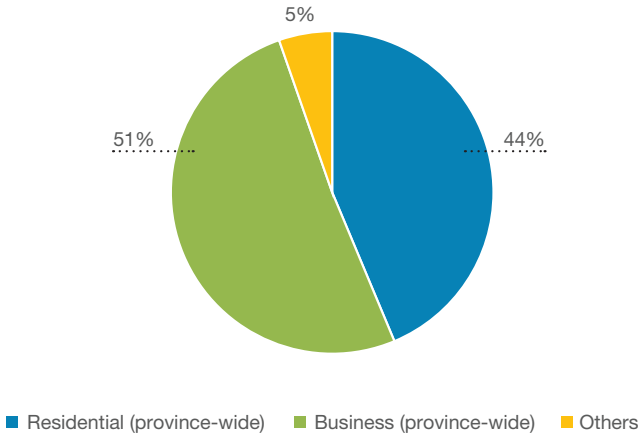
Though the Conservation First Framework only has a target of overall electricity consumption reductions, most conservation initiatives also contribute to peak demand reductions. By the end of 2017, CFF programs had helped reduce peak demand by 649 MW.[23]

C.2.3 Individual program results

CFF programs fall into three broad categories:

- province-wide programs for residential customers
- province-wide programs for business customers (which includes industrial and institutional customers), and
- "other" programs, which includes local and regional programs delivered by specific LDCs that are not offered province-wide.

Figure C.2 shows that business programs produce about half of the energy savings.



Business programs produce about half of the energy savings.

Figure C.2. Percentage contributions of programs to 2016 and 2017 energy savings.

Source: Independent Electricity System Operator, 2017 Report on Energy-Efficiency Activities (Toronto: IESO, December 2018) at 6; Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province-wide Progress"; Independent Electricity System Operator, 2016 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2017) at Tab "Province-wide Progress".

Figure C.3 presents the highest performing programs in 2016 and 2017 collectively. While there are a large number of conservation programs, a few programs are responsible for the bulk of savings.

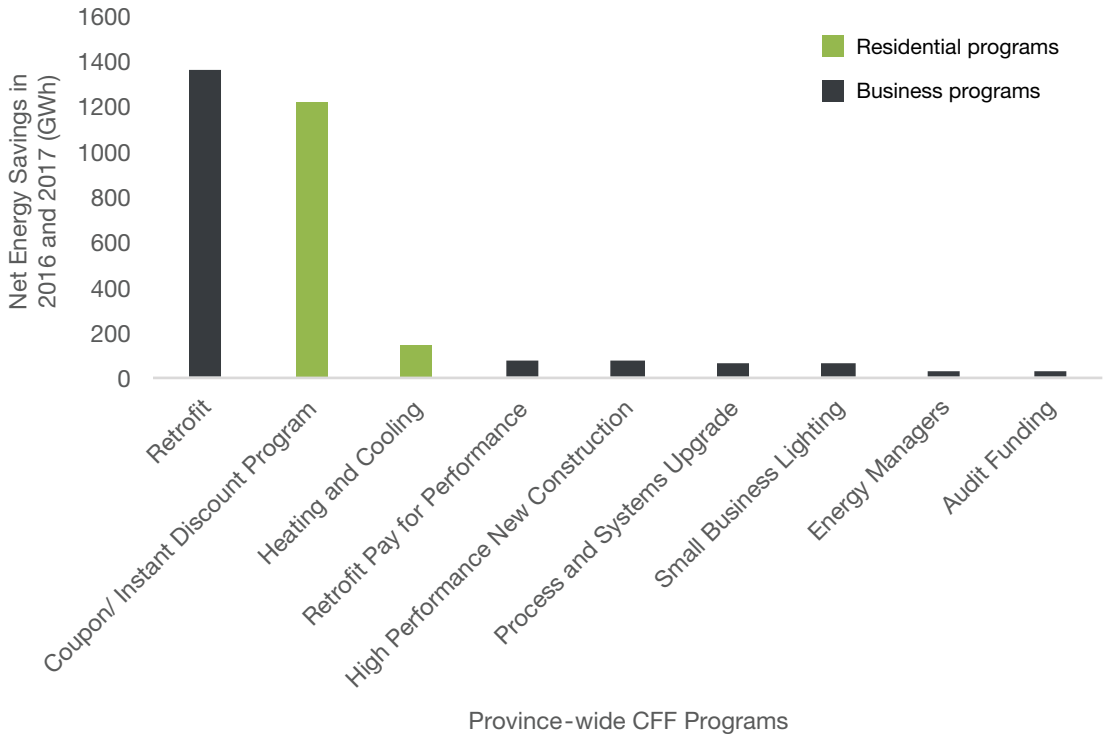


Figure C.3. Leading conservation programs for distribution-connected customers in 2016 and 2017.

Note: The Instant Discount Program replaced the Coupon Program in the fall of 2017.

Source: Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province-wide Progress"; Independent Electricity System Operator, 2016 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2017) at Tab "Province-wide Progress";

The results by individual programs in terms of persistent net electricity savings and participation for 2016 and 2017 are presented in Table C.2. For comparison purposes, updated results of 2015 are also provided. The table highlights the fact that most programs experienced a decline in terms of participation and in terms of net energy savings from the first year of the framework. As explained earlier, the 2011-2014 CDM Framework programs that were completed in 2015 were counted under the CFF's 2015 results. Some of the business programs have long lead times and can be expected to deliver higher results in the latter half of the framework.[24]

Table C.2. 2015, 2016 and 2017 conservation results by program for distribution-connected customers.

Initiatives	Net verified annual energy savings (GWh) persisting until 2020			Participation		
	2015*	2016	2017	2015*	2016	2017
Residential						
Coupon/ Instant Discount**	95.08	477.83	740.20	3,894,321 products	18,999,679 products	29,167,450 products
Heating and Cooling / HVAC Incentives	57.53	77	68.30	127,250 equipment	137,838 equipment	79,915 projects (99,639 equipment)
New Construction/ Residential New Construction and Major Renovation	11.27	2.02	1.80	4,197 homes	204 projects	328 projects (1,898 homes)
Home Assistance / Low Income	14.60	9.19	8.24	17,764 homes	6,566 homes	6,910 homes
Appliance Retirement	0	program discontinued	program discontinued	14,733 appliances	program discontinued	program discontinued
Bi-Annual Retailer Event	73.63	program discontinued	program discontinued	3,205,978 products	program discontinued	program discontinued
Aboriginal Conservation Program	3.24	n/a	n/a	1,586 homes	n/a	n/a
Total residential savings	**255.35**	**566.04**	**818.50**			
Audit Funding / Energy Audit Initiative	45.89	5.52	22.80	586 projects	420 projects	349 projects
Retrofit/ Efficiency Equipment Replacement Incentive	851.88	719.43	644.10	17,580 projects	13,719 projects	8,783 projects
Small Business Lighting	0	13.96	46.43	0 projects	2,485 projects	7,565 projects
High Performance New Construction/ New Construction and Major Renovation	50.04	30.90	46.89	320 projects	241 projects	167 projects

Existing Building Commissioning/ Existing Building Commissioning Incentive	0.32	0.73	0.88	17 projects	30 projects	6 projects
Business Refrigeration	n/a	n/a	4.72	n/a	n/a	1,077 projects
Direct Install Lighting and Water Heating	35.44	program discontinued	program discontinued	18,643 projects	program discontinued	program discontinued
Process and Systems Upgrade / PSU - Project Incentive	274.20	52.74	15.20	24 projects	13 projects	16 projects
Energy Manager / PSU Initiative- Energy Manager	25.18	21.85	11.78	425 projects	123 projects	77 projects
Monitoring and Targeting Program/ PSU Initiative- Monitoring and Targeting	0	0	0	2 projects	0 projects	0 projects
Retrofit Program- Pay-for-Performance	n/a	59.34	19.39	n/a	651 projects	253 projects
Process and Systems Upgrades Program- Pay-for-Performance	n/a	24.14	0	n/a	5 projects	0 projects
Total business savings	**1,282.95**	**928.61**	**812.20**			
Other						
Conservation Fund pilots	8.31	0.27	0.36	n/a	n/a	n/a
LDC Local/Regional programs	0	2.35	144.62	n/a	n/a	n/a
LDC Innovation Fund pilots	0.76	14.67	2.40	n/a	n/a	n/a
Centrally delivered programs	n/a	n/a	14.52	n/a	n/a	n/a
Program enabled savings	10.52	0	0	n/a	n/a	n/a
Other savings	3.24	0	0	n/a	n/a	n/a
Total other program savings	**22.83**	**17.29**	**161.90**	**n/a**	**n/a**	**n/a**
Total	**1,559**	**1,511.94**	**1,793.00**			

*Note: the 2015 results data in this report are updated from the ECO's Every Joule Counts to reflect true-ups and other changes accounted for later by the IESO. For comparison, see pages 86-87 of Every Joule Counts

**Note: the 2017 results include the Coupon program and the Instant Discount Program which was launched mid-2017 and replaced the Coupon program.

Source: Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province-wide Progress"; Independent Electricity System Operator, 2016 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2017) at Tab "Province-wide Progress"; Independent Electricity System Operator, 2015 Annual Verified Local Distribution Company Conservation and Demand Management Program Results Report (Toronto: IESO, January 2016) at 9-11.

Residential programs

In 2016 and 2017, the province-wide Residential programs delivered 44% of the province's savings, as can be seen from Figure C.2. Three programs contributed over 98% of the portfolio's energy savings over these two years. These programs were the Coupon Program and the Instant Discount Program (discussed further in the textbox below), which accounted for 88% of the residential energy savings, and the Heating and Cooling Program, which provides rebates of up to $850 for energy efficient furnace and air conditioner purchases, and accounted for 10% of the residential savings.

Residential energy-efficient LED lighting: how important are conservation programs?

The Coupon/Instant Discount programs for residential customers saw explosive growth.

The Coupon/Instant Discount programs for residential customers saw explosive growth in 2016 and 2017, delivering large increases in energy savings. Ontarians bought 3.9 million products through these programs in 2015, 19 million in 2016, and 29.2 million in 2017. Between 2016 and 2017, the Coupon Program and the Instant Discount Program saw a 73% increase in incremental first year savings.[25] The Coupon program allows customers to redeem coupons for instant rebates on energy efficient product purchases such as light-emitting diode (LED) lights and other energy efficient products such as timers and indoor motion sensors. In fall 2017, it was replaced by the Instant Discount Program, which provides customers point-of-purchase rebates on energy efficient products at several retailers twice a year[26]. 2017 verified results show that the first Instant Discount Program event delivered similar participation and energy savings as the Coupon Program model, and is more cost-effective in terms of program administrator cost.[27] For both programs, the financial incentives are complemented by marketing and promotion (including in-store features) to raise awareness of the incentives and the benefits of energy-efficient technologies.

Energy-efficient LED light bulbs were by far the dominant product incented through these programs. In 2016, redemption of LED coupons accounted for 93% of the coupons and 96% of the program savings.[28] The increase in the number of energy-efficient LEDs bought through the program is impressive, and is due in part to the drop in LED prices and expansion of available LED models.[29]

The ECO was initially skeptical as to whether the program was really responsible for these results. Given the falling prices of LEDs[30] and their growing share of the residential lighting market, wasn't it likely that many of these purchases would have occurred anyway, without the Coupon/Instant Discount Programs and the small financial incentives it offered to customers (only $1-$2 per bulb in 2017)? Amplifying this concern was the switch to the "instant discount" program model – some customers would now be learning about the incentive for the first time when they were already at the cash register (meaning the incentive could not have affected their purchasing decision).

Program evaluations are completed each year for electricity conservation programs that can assess questions of this nature, and can attempt to calculate the influence of conservation programs on customer's actions. The 2016 and 2017 program evaluation reports for the Coupon and the Instant Discount Programs provide interesting insights on the role of the program in speeding up Ontario's shift to energy-efficient lighting.

New energy efficiency standards took effect in 2014 that essentially eliminated sales of

traditional incandescent bulbs.[31] However, analysis of similar markets shows that much of the market space has been filled by halogen lightbulbs that are only slightly more efficient, instead of the much more efficient LEDs (or compact fluorescent lamps). Even by the fourth quarter of 2017, these inefficient halogen and incandescent lighting technologies accounted for almost 60% of new residential lighting sales.[32] Looking at the total number of bulbs in service, the share of energy-efficient LEDs is even lower, perhaps in the order of 20%.

The evaluation reports assess the question of what type of lighting customers would have purchased in the absence of the Coupon/Instant Discount program through participant surveys. Survey results in 2016 indicated that roughly 40% of participants in the Coupons program would have purchased less-efficient halogen/incandescent lighting in the absence of the program, while 60% would have purchased efficient CFLs or LEDs.[33] Survey results in 2017 further indicated that about 70% of participants were using energy-efficient bulbs purchased through the program as early replacements for older bulbs that were still working (as opposed to replacing bulbs that had burned out).[34] The calculated energy savings attributed to the program are adjusted based on these results.

In the 2017 program evaluation for the Instant Discount program, a second method of assessing the program impact was used - comparing participating retailers' sales before, during, and after the fall 2017 Instant Discount event to determine the net sales lift from the program.[35] The results of this analysis were striking. Sales of LEDs during the event were a remarkable twelve times as high as in an average month.[36] This is convincing evidence that the Instant Discount program, through a combination of financial incentives and marketing and promotion of energy-efficient technology) is having a real and important impact in transforming Ontario's residential lighting sector to energy-efficient LEDs.

This is convincing evidence that the program is having a real and important impact in transforming Ontario's residential lighting sector to energy-efficient LEDs.

LEDs, however, may not deliver as much value to the electricity system and to greenhouse gas reductions as some other types of conservation measures (such as space heating and cooling) because the timing of their electricity use is not well correlated with Ontario's times of peak demand, when natural gas is used to generate electricity. This issue is discussed in **Chapter 2** of this report.

The Heating and Cooling Program contributed 10% to the residential portfolio's performance in 2016 and 2017. A concern though is that there has been a 22% drop in participation between 2015 and 2017 in the program.[37] This is because air conditioners of a certain energy efficiency level, which used to account for almost 50% of program activity, are now considered standard technology, and are no longer eligible for incentives.[38] Several changes were made to the program in 2017 to increase participation and drive more savings, including adding incentives for air source heat pumps and smart thermostats for electrically heated homes, circulator pumps, and ultra high-efficiency air conditioners.[39] Third-party evaluation indicated that contractors remain a key driver of the program since a contractor recommendation goes a long way in the customer's decision to upgrade equipment and take part in the program.[40]

Business programs

Under the 2015-2020 Conservation First Framework, the IESO has merged the commercial and institutional initiatives (business) and industrial initiatives under "business programs". For consistency, the ECO has also merged the two suites of program, as presented in Table C.2. Figure C.2 shows that business programs delivered close to 51% of the province's energy savings collectively in 2016 and 2017. The Retrofit Program (including the Pay-for-Performance retrofit projects) continued to be the strongest performing provincial program. It contributed to close to 83% of the portfolio's savings (for 2016 and 2017 together) and 44% of overall savings collectively.[41] Lighting measures account for a majority of the savings in the program, with custom lighting responsible for 45% of first-year savings in 2017.[42] Non-lighting measures contributed about 21% of the savings during the same period.[43]

Several changes have been made to the Retrofit program to increase participation and savings for the rest of the framework, including updating savings and incentive values of non-lighting prescriptive measures, removing measures that had low uptake, adding new measures for the agricultural sector and removing some reporting and evaluation requirements.[44]

Other business programs like the High Performance New Construction (HPNC) Program and the relaunched Small Business Lighting Program each contributed less than 5% each to the portfolio's 2016-17 results.[45] The HPNC program saw several amendments at the beginning of 2017 to increase participation. Changes included removing certain building permit requirement timelines, adjusting custom project incentives to better align with the Ontario Building Code, updating modeling requirements and software and updating program processes and tools to simplify the application and approvals process.[46]

The Small Business Lighting Program saw a 212% increase in participation between 2016 and 2017.[47] The program underwent changes in August 2018 which included an increase in incentives, improvements in capturing realization rates for more accurate savings calculations and adjustments to the program measure list.[48]

The Business Refrigeration Program, which was launched as a local program by Alectra Utilities during the 2011-2014 CDM Framework and continued to run under CFF, was expanded to a province-wide offering in 2017, and saw over 4.5 GWh of energy savings. The Audit Funding Program observed a 715% increase in net verified energy savings and a 178% increase in net verified demand savings between 2016 (not including true-ups) and 2017.[49] This increase in net verified savings is due to a large increase in per audit energy savings and the program's participation and had a positive impact on the program cost effectiveness compared to 2016.[50]

The Process and Systems Upgrade (PSU) Program for larger industrial and business customers continued to have low participation and savings compared to its performance in 2015. This is mainly because 2015 savings included a large number of 2011-2014 projects that completed that year and therefore saw higher results. Given the long lead time, participation and results are expected to ramp up in the last 2 to 3 years of the framework.

PSU results could decline in future years due to a change in project eligibility.

However, PSU results could decline in future years due to a change in project eligibility. Behind-the-meter generation (BMG) projects, which reduce the need for electricity from the grid through on-site generation, accounted for 56% of the energy savings from the industrial scale conservation programs (including the PSU program) in 2017.[51] Combined heat and power (CHP) generation, a form of BMG which uses one fuel source (usually a fossil fuel like natural gas) to produce two outputs- electricity and heat, was considered a CDM activity when the CFF launched in 2015 and

was therefore eligible for incentives under the PSU Program.[52] However, after the previous government's (now cancelled) Climate Change Action Plan was established in 2016, a Ministerial Directive was issued in 2017 that stated that CHP project applications that use natural gas or other fossil fuels would not be approved as a CDM activity after July 1 2018 because of the associated GHG emissions.[53] According to the 2016 evaluation report, CHP PSU projects resulted in a net increase of 20,322 tonnes CO_2e.[54]

While there was initial concern in the industry about the impact the cancellation would have on LDC targets, the industry did anticipate the change based on government discussions. Several LDCs, such as Entegrus and North Bay Hydro, completed their CHP projects prior to the July 2018 deadline, and therefore the results were counted towards their respective targets.[55] During the 2017 industrial portfolio evaluation survey, approximately 32% of the LDCs were very concerned that they would not be hitting their targets because a majority or the entirety of their industrial projects were CHP.[56] In April of 2018, the PSU program went through several changes such as increasing participant incentives, removal of the preliminary engineering study requirement, extension of third party participation allowance and simplified participant agreement requirements.

Other programs like the Energy Manager Initiative did not see high direct savings but their roles also include the identification of capital improvements through PSU and the Industrial Accelerator Program.[57] So the Energy Managers help facilitate higher participation in other incentive programs, and bring about other benefits such as new jobs and the development of new skills, as discussed in **Chapter 1** of this report.

Other programs

Province-wide programs for business and residential customers account for the bulk of savings from the Conservation First Framework, but several other types of programs accounted for about 5% of savings in 2016 and 2017. Figure C.4 breaks down the "other" savings by the different categories for 2016 and 2017.

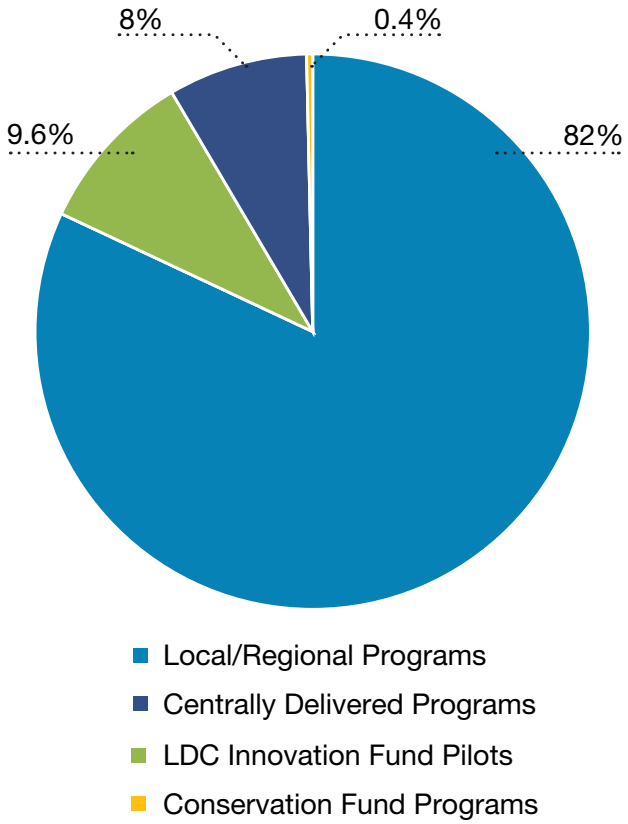


Figure C.4. The different categories of "other" savings in 2016 and 2017.

Source: Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province-wide Progress"; Independent Electricity System Operator, 2016 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2017) at Tab "Province-wide Progress".

The IESO began reporting results from local and regional LDC programs, LDC Innovation Fund pilots and Conservation Fund pilots in 2016. Several of these initiatives have now started producing energy savings, indicating that the approval process under CFF has been much more conducive to encouraging innovation to meet local/regional needs. As of the end of 2016, 19 LDC Innovation Fund pilots and 12 local and regional programs have been launched in the province.[58] Another 21 projects have been approved under the Conservation Fund between 2015 and 2017.[59]

For the first time in 2017, local/ regional programs delivered a non-trivial share of overall savings.

Local/regional programs

For the first time in 2017, local/regional programs delivered a non-trivial share (roughly 5%) of overall CFF savings.[60] Programs that produced a majority of those results include the Social Benchmarking Program, the PUMPSaver Program and the Pool Saver Program that were responsible for over 90% of the savings from local/regional programs.[61] All three of these programs were delivered by multiple LDCs across the province.

Some local programs and pilots, while not being cost effective, have been able to offer conservation programs to more vulnerable customers and offer them benefits beyond just electricity bill savings. The textbox "CustomerFirst's Home Energy Assessment and Retrofit" highlights one such pilot.

CustomerFirst's Home Energy Assessment and Retrofit pilot[62]

CustomerFirst is a turnkey clean energy electricity conservation service provider that implements electricity conservation and renewable energy solutions programs for 10 multiple LDCs in across the province, mostly based in Northern Ontario. The company is jointly owned by five LDCs as an affiliate business and it represents the largest joint Conservation and Demand Management (CDM) Plan under the Conservation First Framework in the province. CustomerFirst designed and implemented a pilot under the IESO's Innovation Fund called the Home Energy Assessment and Retrofit (HEAR) pilot program. The HEAR program was delivered to electrically heated residential customers with high-usage homes in 6 LDC service territories - North Bay Hydro, Northern Ontario Wires, Newmarket-Tay Power, Entegrus Powerlines, PUC Distribution and Greater Sudbury Hydro. The initiative helped electrically heated residential customers reduce their energy consumption, which represents 30% of the residential customers of those LDCs, by providing them with free in-home use energy assessments,by directly installing high energy efficiency upgrades and also by assessing the feasibility of installing smart programmable thermostats.[63] Direct install measures included block heater timers, LED lights, power bars, low flow showerheads and electric water heater blankets. Customers were provided with a custom report based on the in-home assessment that outlined additional actions they could take to achieve further savings. 836 households participated in the pilot, which exceeded the initial target of 750.[64]

The one-year pilot, with a budget of less than $1 million, achieved net annual savings of 375 MWh and demand savings of 59 kW.[65] Evaluation results showed that the average participating household was able to reduce their annual electricity usage by 448 KWh.[66] The evaluation report, however, did not provide an estimate on what this translates to in terms of bill savings. However, 97% of respondents were satisfied with their overall experience with the pilot and 66% of responding participants reported that the pilot had resulted in the customer taking additional actions to save energy. The evaluation report stated that the pilot "met an underserved market need, namely northern and rural electrically-heated residential customers with high electricity usage which lacked program opportunities".[67]

Due to the high initial start-up costs and savings results of the pilot and the lower than expected results, the pilot did not fare well in terms of cost-effectiveness results were lower than anticipated, with Total Resource Cost (TRC) at 0.28 and Program Administrator Cost (PAC) at 0.25.[68] The evaluation report stated that offering additional measures that offer higher savings and providing more education about the installed measures could work

to improve increase cost-effectiveness if the pilot were implemented on a wider scale.[69] The program was considered to be well executed by the collaborating LDCs and successful in terms of targeting a section of the population who faced higher electricity costs.

Centrally delivered programs

$400 million of the $2.2 billion budget for the six-year Conservation First Framework was allocated for central services and programs delivered by the IESO. Programs delivered directly by the IESO have taken on a larger role recently because of direction received from the Ministry of Energy.[70]

The IESO is centrally funding and delivering two programs/pilots from their allotted budget that launched in 2017: the Energy Performance Program for multi-site customers and the Whole Home Pilot, which is delivered by the province's gas utilities.[71] The Energy Performance Program is discussed below, while the Whole Home Pilot, which combines electric and gas conservation measures for residential houses, is discussed in **Chapter 2**.

Energy Performance Program (EPP) for multi-site customers

The IESO was directed by the Minister of Energy in June 2016 to develop and centrally deliver a new pay-for-performance (P4P) program that offers conservation incentives for customers that have facilities across multiple service territories.[72] Under a pay-for-performance incentive mechanism, participants are rewarded for whole building energy performance through incentives based on verified performance set at a predetermined $/kWh rate for savings.[73] This gives the customers choice and flexibility to implement capital and non-capital measures as long as they lead to energy savings.[74]

Participants are rewarded for whole building energy performance through incentives.

The Energy Performance Program (EPP) launched in December of 2016 with a total budget of $24 million over the course of the framework. As of June 2018, 162 facilities from nine different companies across Ontario in 42 LDC service territories have enrolled in the program. Participants include 45 schools, 14 office and retail buildings, two multi-unit residential buildings and 101 grocery stores.[75] In 2017, the IESO reported verified net energy savings of over 7.9 GWh from 39 of the participants[76], and indicates that the EPP is generating twice the savings for each dollar spent compared to the province-wide Retrofit Program, which is the CFF's most successful program. Almost 50% of the energy savings came from improved operational practices and did not require capital expenditures on new technology. Figure C.5 shows the estimated savings from different measures installed under the program in 2017.

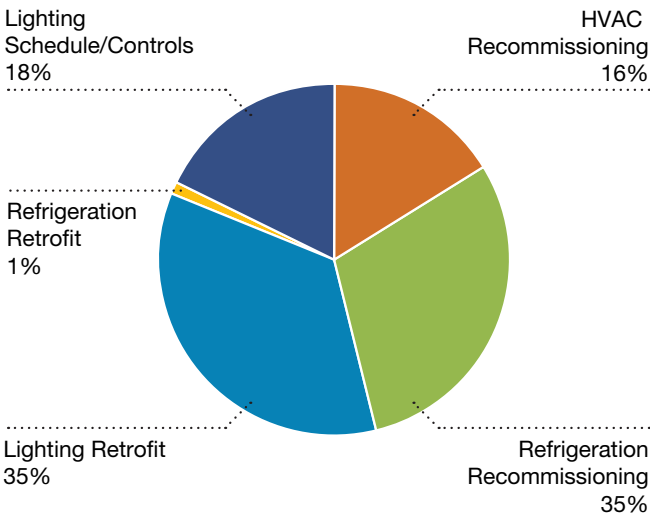


Figure C.5. Estimated savings from measures installed under the EPP.

Source: Independent Electricity System Operator, Program Year 2017 Evaluation Report: Energy Performance Program for Multi-site Customers by EcoMetric Consulting, LLC (IESO: Toronto, November 2018) at 24.

The IESO has indicated that this program has great potential beyond 2020 if it is expanded to more customers as it allows for deeper savings and encourages innovation by promoting whole facility energy conservation. There could be more customer participation if funding is made available beyond 2020, eligibility requirements are lowered to allow smaller customers and if the modeling incentive is increased.

Table C.3 lists the performance of centrally-delivered IESO programs for distribution-connected customers in 2017.[77]

Table C.3. Performance of IESO only programs in 2017.

Programs	Net incremental 2020 annual energy savings (GWh)	Net incremental 2020 peak demand savings (MW)
Energy Performance Program	7.92	0.00
Whole Home Pilot	6.60	0.93

Source: Independent Electricity System Operator, information provided to the ECO (15 January 2019).

The central delivery of the Home Assistance Program and other programs

In December 2016, the Minister of Energy issued a direction that required LDCs to revise their CDM plans to ensure all customers had access to the province-wide CDM programs.[78] This suggested that, in the government's view, certain customer segments were not getting adequate access to conservation programs from all LDCs and therefore corrective action was required. LDCs had until May 1, 2017 to resubmit their CDM plans. Any province-wide programs not offered by LDCs were to be picked up for delivery by the IESO, as per the direction. The Directive also asked the IESO to create a budget from within its allotted CFF budget to deliver these programs and stated that the results from these IESO delivered programs would not count towards the LDC's targets.

In particular, the directive seemed intended to address the lowered level of availability and participation in the program for low-income customers (Home Assistance Program). Participation in the Home Assistance Program (HAP) had dropped by almost more than 50% between 2015 and 2016. It then picked up slightly in 2017 (36% increase between 2016 and 2017).[79] 22 more LDCs participated in HAP in 2017 compared to 2016, but 75% of the participation came from the five largest LDCs and one medium-size one.[80] Participants reported a high level of satisfaction, with 92% saying they were satisfied with the program.[81] Delivery agents and community partners also echoed this sentiment.

However, the government remained concerned that the LDC-delivery model was not reaching all eligible low-income customers in the province. On August 4, 2017, the Minister issued another Directive to the IESO concerning the LDC delivery the program. The Direction stated that "there remains an opportunity to further improve the availability of and access to CDM programs targeted to the low-income customer segment through IESO delivery"[82] and amended the Framework to mandate that the IESO centrally design, fund and deliver a province-wide low income program beginning January 1, 2018.

Though the Directive stated that the IESO may continue to allow an LDC to deliver the low-income program if it can demonstrate the commitment to serve the customer segment[83], the Home Assistance Program is now an IESO delivered CDM program. LDCs have the option to access funds to promote the program directly to its customers or it can engage the IESO's central HAP vendor to participate in the program's delivery.[84] Currently, there are four LDCs participating in promoting the IESO's delivery of the program, but no LDCs to date have been approved to engage with the IESO's vendor to deliver the program in their jurisdiction.[85]

This issue reflects the long-standing tension between maximizing cost-effectiveness and making conservation support available to lower-income

This issue reflects the tension between maximizing cost-effectiveness and making conservation support available to lower-income customers.

customers (such programs generally have lower energy savings per dollar spent). This is because programs geared towards lower-income customers generally have lower energy savings per dollar spent. While the results of the first year of central delivery will not be available until 2019, several LDCs have noted to the ECO that the shift to central delivery may have been short-sighted on the part of the province. According to LDCs, the industry was delivering HAP to the best of its abilities under target and budget constraints and larger LDCs could have delivered in jurisdictions where smaller LDCs could not vs. the IESO taking over the whole program.[86] This change meant LDCs had to cancel their existing HAP vendor contracts when the IESO's central delivery vendor took over, creating confusion and delivery issues.

As of the time of writing this report, the Home Assistance Program is the only program that has been taken over by the IESO from all LDCs, however the IESO is now also filling some gaps in program availability for other programs in certain LDC service territories.[87] To date, the IESO has enrolled over 8,500 homes in its centrally managed HAP and around 3000 projects have been completed.[88]

The increased role IESO is playing in central delivery of programs is the reason that the increases in budget ($220 million) and target (0.4 TWh) reassigned from the Industrial Accelerator Program have been allocated to IESO centrally-delivered programs, and not to LDCs.

C.2.4 Individual LDC performance

LDCs continued to perform strongly in 2016 and 2017, with over 85% (59 of 68) already achieving 50% of their allotted targets by the mid-term of the framework. 7 LDCs have already achieved over a 100% of their allotted 6-year targets.[89] Most LDCs that achieved 50% or more of their 6-year targets at the end of 2017 were eligible to receive a Mid-Term Incentive in 2018.[90] The IESO expects that the underperforming LDCs, especially those in more remote areas of the province, will catch up with their CFF goals as program activity accumulates in the later stages of the framework and equipment is transported to the locations seasonally.[91]

Factors that led to higher than average performance for specific LDCs include:

- Completion of large CHP projects[92]
- Strong participation in the Coupon and Retrofit programs, driven by LDC promotion to customers
- Success with the Energy Manager Initiative, specifically for the large LDCs[93] (see the text box on Energy Managers in **Chapter 1** of this report)

Table C.4 lists LDCs' persistent energy savings until the end of 2017 and their progress to allocated CFF targets.

Table C.4. Individual LDC performance under the 2015-2020 Conservation First Framework as of December 31, 2017.

LDC	Net verified Persistent Energy Savings to 2020 (GWh)	Progress to Allocated Target (%)
Alectra Utiliites*	998.2	62
Algoma Power Inc.	4.74	63
Atikokan Hydro Inc.	0.7	61
Attawapiskat Power Corporation	0.27	53
Bluewater Power Distribution Corporation	26.33	42
Brantford Power Inc.	36.44	67
Burlington Hydro Inc.	61.96	63
Canadian Niagara Power Inc.	23.99	84
Centre Wellington Hydro Ltd.	6.16	71
Chapleau Public Utilities Corporation	0.7	67
COLLUS PowerStream Corp.	11.63	69
Cooperative Hydro Embrun Inc.	1.38	77
E.L.K. Energy Inc.	6.66	41
Energy+ Inc.**	127.32	126
Entegrus Powerlines Inc.	73.7	96
EnWin Utilities Ltd.	80.97	54
Erie Thames Powerlines Corporation	20.21	73
Espanola Regional Hydro Distribution Corporation	1.94	80
Essex Powerlines Corporation	33.66	107
Festival Hydro Inc.	28.87	83
Fort Albany Power Corporation	0.24	71
Fort Frances Power Corporation	1.97	49
Greater Sudbury Hydro Inc.	31.34	90
Grimsby Power Incorporated	8.06	74
Guelph Hydro Electric Systems Inc.	102.23	103
Halton Hills Hydro Inc.	19.58	63
Hearst Power Distribution Company Limited	5.54	174
Hydro 2000 Inc.	0.71	52
Hydro Hawkesbury Inc.	4.77	60
Hydro One Networks Inc.	986.67	81
Hydro Ottawa Limited	276.09	70
InnPower Corporation	9.57	74
Kashechewan Power Corporation	0.28	54
Kenora Hydro Electric Corporation Ltd.	3.29	63
Kingston Hydro Corporation	19.28	56
Kitchener-Wilmot Hydro Inc.	88.15	83
Lakefront Utilities Inc.	7.42	61

Lakeland Power Distribution Ltd.	11.75	74
London Hydro Inc.	124.59	63
Midland Power Utility Corporation	12.01	111
Milton Hydro Distribution Inc.	35.16	78
Newmarket-Tay Power Distribution Ltd.	23.32	64
Niagara Peninsula Energy Inc.	43.75	59
Niagara-on-the-Lake Hydro Inc.	10.5	90
North Bay Hydro Distribution Limited	26.15	129
Northern Ontario Wires Inc.	3.58	83
Oakville Hydro Electricity Distribution Inc.	70.1	76
Orangeville Hydro Limited	10.38	73
Orillia Power Distribution Corporation	7.4	45
Oshawa PUC Networks Inc.	52.31	72
Ottawa River Power Corporation	7.15	82
Peterborough Distribution Incorporated	23.51	62
PUC Distribution Inc.	24.42	92
Renfrew Hydro Inc.	2	48
Rideau St. Lawrence Distribution Inc.	2.95	59
Sioux Lookout Hydro Inc.	1.77	48
St. Thomas Energy Inc.***	10.7	61
Thunder Bay Hydro Electricity Distribution Inc.	51.75	107
Tillsonburg Hydro Inc.	7	62
Toronto Hydro-Electric System Limited	981.95	63
Veridian Connections Inc.	81.43	53
Wasaga Distribution Inc.	5.82	92
Waterloo North Hydro Inc.	53.68	65
Welland Hydro-Electric System Corp.	10.34	41
Wellington North Power Inc.	2.21	37
West Coast Huron Energy Inc.	3.83	47
Westario Power Inc.	14.41	63
Whitby Hydro Electric Corporation	32.64	56
Total	**4859.58**	**68**

LDC has achieved less than 50% of target	LDC has achieved greater than 50 but less than 100% of target	LDC has achieved greater than 100% of target

*Note: As of September 2017, Horizon Utilities, Enersource and Powerstream merged to become Alectra Utilities Inc. The merged utility also purchased Hydro One Brampton, which became part of the new LDC. The new LDC's target is a culmination of all the merged LDCs' individual targets.

**Note: Energy+ Inc. is an amalgamation of Brant County Power and Cambridge and North Dumfries Hydro Inc. The new LDC's target is a culmination of all the merged LDCs' individual targets.

***Note: St Thomas Energy has now merged with Entegrus, but was still a separate LDC with its own target at the end of 2017.

Source: Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "LDC Rankings"

C.3 Industrial Accelerator Program (IAP) for large customers

In addition to the oversight and collaboration with the LDCs in delivering the 2015-2020 Conservation First Framework, the IESO is mandated to deliver 1.3 TWh (this was originally 1.7 TWh) of energy efficiency savings from its larger customers (primarily industrial customers) who are directly connected to the high-voltage transmission network. The program that delivers these savings is the Industrial Accelerator Program (IAP).

The IAP is designed to help transmission-connected customers with financial incentives to implement major energy conservation projects in their facilities. There are currently four initiatives under this program (similar to the initiatives of the same names offered to smaller distribution-connected customers), which encourage investment in innovative capital projects and retrofits that help reduce electricity consumption and therefore save money for the customers:

- Retrofit
- Process and Systems, including small capital projects
- High Performance New Construction
- Energy Managers

Table C.5. Performance of Industrial Accelerator Program, 2016 and 2017.

Year	Net incremental 2020 annual energy savings (GWh)	Net incremental 2020 peak demand savings (MW)
2016	113.02	82.49
2017	101.00	11.5

Source: Independent Electricity System Operator, information provided to the ECO (8 August 2018); Independent Electricity System Operator, 2017 Report on Energy Efficiency Activities (Toronto: IESO, December 2018) at 6.

Verified results from the IAP have been lower than expected. By the end of 2017, the halfway point of the 2015-2020 framework, the IAP had only achieved 21.5% (280 GWh) of the amended 1.3 TWh target in three years. The IESO is currently consulting on several amendments to the IAP to bring the program in line with the LDC-delivered Process and Systems Upgrade (PSU) program. The PSU program changes are expected to increase customer participation, shorten project cycles and increase cost-effectiveness, so the same benefits could potentially help the IAP.[94]

As discussed earlier in the chapter, the lower performance of the IAP has meant that the target for IAP has been reduced by 0.4 TWh, and reallocated to programs for distribution-connected customers. The IAP six-year budget has been correspondingly reduced from $500 million to $280 million.[95]

C.4 IESO's demand response programs

Demand response is a specific category of conservation initiatives designed to reduce electricity use when the electricity system is under stress, often on days of system-wide peak demand (e.g., hot summer weekday afternoons or cold weekday evenings). Meeting peak demand is exceptionally expensive and drives a disproportionate share of system costs.

Meeting peak demand is exceptionally expensive and drives a disproportionate share of system costs.

Demand response is usually achieved by customers reducing or curtailing some share of their electricity use in response to signals from the system operator. Demand response is focused on delivering instantaneous reductions in peak demand (measured in MW), and usually delivers only negligible overall

electricity savings (because it is only activated for short periods, and some of the electricity use that is curtailed at these times may be shifted to other times). In contrast, the conservation programs described earlier in the chapter deliver both electricity savings and peak demand savings, but their primary metric is overall electricity savings.

Under the CFF, the responsibility for reducing peak demand through demand response initiatives is with the IESO. The IESO previously had a target of using demand response to meet 10% of provincial peak demand by 2025. However, in its latest Long-Term Energy Plan, the province stated that demand response capacity realized each year will depend on system needs and the competitiveness of demand response with other resources. In other words, the economic cost of demand response will be compared with electricity supply-side options, and there is no longer a specific target for how much demand response will be procured by action.[96]

In 2016 and 2017, the IESO ran two initiatives to reduce peak demand: the annual demand response (DR) auction and the Capacity Based Demand Response (CBDR) program. The CBDR was discontinued in late 2018.The IESO also has demand response capacity available through peaksaver PLUS programs.[97]

C.4.1 Annual Demand Response (DR) Auction

The IESO's Demand Response (DR) Auction, held annually in December, provides a competitive process by which potential DR providers offer to commit to reducing their consumption during hours of provincial peak demand and being compensated for that reduction, while being held to mostly the same performance obligations by the IESO as generators and other electricity market participants.[98]

The Demand Response Auction has been successful in procuring demand response at lower prices. The most recent auction (held in December 2018 for the 2019 period) procured more DR than the target capacity, due to low prices (a 30% price decrease from the previous year's auction and a 43% price decrease from the first auction held in 2015).[99]

The Demand Response Auction has been successful in procuring demand response at lower prices.

Devices from the now-discontinued *peaksaver* PLUS program (a program that installed a programmable thermostat in Ontario homes and small businesses) that are still operational can be aggregated (e.g., by electric utilities) to participate in the DR auction. Several successful participants in the DR auction are residential DR, which may be based on aggregated *peaksaver* PLUS devices.[100] However, the amount of residential DR procured through the auction (13 MW in 2018) is much lower than the capacity of the former *peaksaver* PLUS program (164 MW).

C.4.2 Capacity Based Demand Response (CBDR)

The Capacity Based Demand Response (CBDR) Program was a transitionary program for participants with contracts under a previous demand response program (Demand Response 3) that activated these contracted customers using market signals. This program was active in 2016 and 2017 and ended in October 2018. Expired CBDR contract capacity was rolled into the IESO DR auction target capacity for subsequent DR auctions.[101]

C.4.3 Integrating demand response into Market Renewal[102]

With capacity need emerging from 2020 onwards and the first incremental capacity auction currently being targeted for as early as end of 2022, the IESO plans to evolve the 2019 DR auction by allowing more resources to compete to meet the emerging capacity needs.[103] Evolution of the DR auction will be staged, allowing both the IESO and market participants to continue to learn and improve our processes as capacity needs increase.[104] This staging will culminate

in the implementation of the incremental capacity auction design that IESO has been developing with stakeholders and is expected to be up and running by as early as the end of 2022.

Eventually it is envisioned that demand response providers, along with generators and importers, will compete in a capacity auction market (Incremental Capacity Auction) to meet Ontario's resource adequacy needs, under the IESO's Market Renewal initiative.

The IESO plans to engage with stakeholders on the proposed changes for the next DR auction through various working groups. The IESO is currently engaging stakeholders on how to integrate demand response into Market Renewal[105], and, specifically through the Demand Response Working Group, to evolve and improve the existing demand response in the IESO-administered markets.[106]

C.4.4 Demand response results

Table C.6 lists the peak demand capacity provided by DR programs in 2016 and 2017. Unlike the savings from conservation programs presented earlier, these savings from demand response initiatives do not represent actual reductions in peak demand, they represent the amount of demand response procured (except for the now discontinued peaksaver PLUS program).[107] This is the potential for peak demand reduction – how much peak demand could be reduced if all of the demand response resources under contract are activated.

Actual activations of demand response resources depends on the system need (see next section). In addition, DR participants may not be able to reduce electricity use by the full contracted amount if called upon (although the contracts for DR participants are structured such that participants may incur non-performance charges for not meeting their performance obligations) – the results from 2017 activations suggest that roughly 75-85% of contracted/ procured demand response will be delivered when activated.

Table C.6. Demand Response capacity provided in 2016 and 2017.

Program	2016 contracted peak demand reduction (MW)	2017 contracted peak demand reduction (MW)
IESO Capacity Based Demand Response	159.0	159.0
IESO Demand Response Auction	391.5	455.2
IESO Demand Response Pilot	69.0	25.9
peaksaver Plus[108]	163.8	164.0

Source: Independent Electricity System Operator, information provided to the ECO (8 August 2018 and 15 January 2019).

C.4.5 DR activations in 2016 and 2017

The value of demand response as a resource was demonstrated in September 2017, when Ontario experienced an extended fall heatwave[109] and electricity demand spiked (both September 25 and September 26 were in the five days of the year with the highest system-wide peak demand).[110] The CBDR program was activated twice during this heatwave where on each occasion the IESO activated over 150 MW of DR and over 110 MW was delivered (roughly 75%).[111] The province's peaksaver PLUS program, which was discontinued at the end of 2017, was also activated on these two days. On both occasions, peaksaver PLUS curtailed approximately 175 MW of peak demand, slightly higher than predicted.[112] This event was the only need-based activation of DR in 2017. There was also one DR activation in 2016 that lasted for 4 hours and had a 75% compliance rate from participants.[113]

The value of demand response as a resource was demonstrated in September 2017, when Ontario experienced an extended fall heatwave.

Demand response resources procured through the DR auction were not activated in 2016 or 2017, which indicates that electricity market prices never went high enough for the IESO to call on DR. In 2017, the IESO did initiate 7 test activations to confirm the availability of these resources, and approximately 85% of activated capacity was delivered.[114]

C.5 Electricity conservation spending

The 2013 Long-Term Energy Plan had outlined a total budget of $2.2 billion for the CFF (LDC spending and IESO spending), $0.4 billion for demand response initiatives, and $0.5 billion for the IAP.[115] Total spending on electricity conservation initiatives which includes spending on the CFF, the IAP, and DR was roughly $391 million in 2016 and $541 million in 2017 [116]. This represents approximately 2% of the annual costs of running Ontario's $21 billion electricity system. Most of this spending is for CFF and IAP and is recovered through the Global Adjustment charge, accounting for roughly 3.78% of the Global Adjustment in 2016 and 3.25% in 2017.[117] Demand response spending, on the other hand, is funded through the IESO's Wholesale Market Service Charge.[118]

Total spending on electricity conservation was approximately 2% of the annual costs of running Ontario's $21 billion electricity system.

Figure C.6 shows the amount and percentage of conservation costs attributed to CFF programs, the Industrial Accelerator program, and demand response initiatives, respectively, in 2016 and 2017.

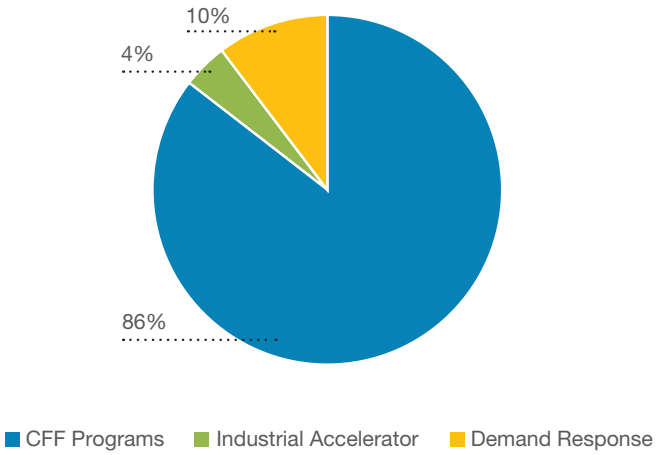


Figure C.6. Percentage of conservation costs for 2016 and 2017 (collective).[119]

Source: Independent Electricity System Operator, information provided to the ECO (15 January 2019); Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province Wide Progress"; Independent Electricity System Operator, 2016 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2017) at Tab "LDC Rankings".

As Figure C.6 shows, spending on CFF programs dominates the overall conservation budget. In 2016 and 2017 together, $797 million was spent on the CFF programs, which includes the programs delivered under the 2015-2020 framework and programs being completed from the 2011-2014 Conservation and Demand Management Program.[120] The CFF spending includes incentives to participants of conservation programs, LDC program administrative costs, and the IESO's Central Services (which include LDC performance incentives, program evaluations, market research and LDC Innovation Pilot funding). See Figure C.7 for a breakdown of CFF spending per expense category.

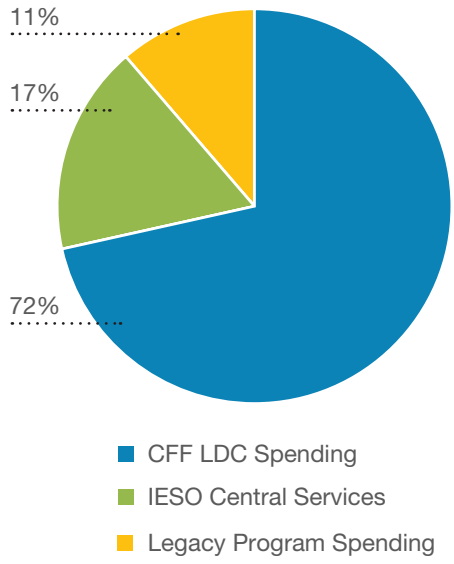


Figure C.7. Spending on CFF Programs by expense category

Note: The Mid-Term Incentive is part of the IESO Central Services budget.

Source: Independent Electricity System Operator, information provided to the ECO (19 February 2019).

One of the major expenditures that took place at the end of 2017, halfway through the CFF, is the payment of the Mid-Term Incentive (MTI) to eligible LDCs, as discussed in the individual LDC performance section. According to the IESO-LDC Energy Conservation Agreement, LDCs that achieved 50% or more of its individual or joint CDM target is eligible to receive this incentive, which is a portion of its Achieving Target Incentive.[121] This incentive is paid from the Central Services portion of the total CFF budget.[122] 61 LDCs were eligible for the MTI in 2018, for a total amount of $68 million.[123]

At the end of 2017, the province's LDCs had spent 33% of their $1.8 billion CFF budget in the first half of the framework, but had achieved 69% of their aggregate target.[124] This is due in part to stronger program results and cost-effectiveness than expected. However, it is also due to the fact that conservation projects completed in 2015 or later that were initiated through 2011-2014 legacy programs are counted towards the 2015-2020 target, but were funded from the previous conservation framework, not the CFF budget.

Since most of the energy savings in 2015 came from the 2011-2014 legacy programs, most of the spending also came from the previous CDM framework. The Province's LDCs started 2016 having spent only 1.3% of their $1.8 billion CFF budget. Some conservation spending from the pre-CFF framework continued in 2016, although at a lower amount ($90.15 million).[125] The IESO notes that it continues to have payment obligations from the legacy framework (primarily incentive payments to customers as projects are completed) that do not have a final deadline.[126] The end result of this legacy spending is that, as the Ontario Energy Board (OEB) has noted, this has put LDCs in an advantageous position since they now have a larger than projected budget for the rest of the framework.

In total, only $570 million of the $797 million spent in 2016 and 2017 on CFF conservation programs comes from the 2015-2020 LDC CFF budget of $1.8 billion. Figures C.8, C.9 and C.10 break down this spending in more detail.

Figure C.8 shows the breakdown of the $570 million spending from the LDC budget by type of expense in 2016 and 2017 (collectively).

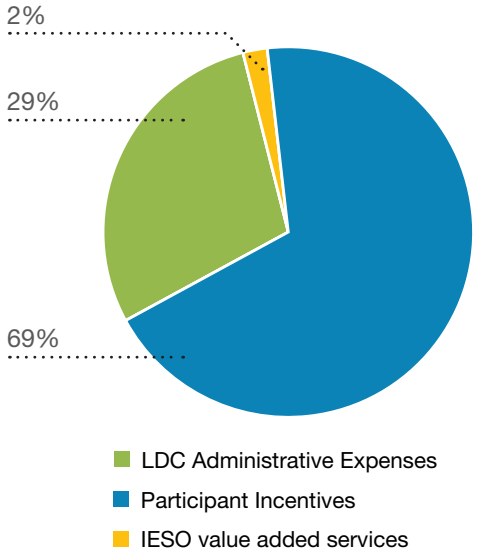


Figure C.8. 2016-17 Conservation First electricity conservation program spending by type of expense.[127]

Source: Independent Electricity System Operator, 2016 Annual Verified Local Distribution Company Conservation and Demand Management Program Results Report (Toronto: IESO, March 2018) at 11-13, Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province Wide Progress".

Figure C.9 presents spending in the different sector portfolios in 2016 and 2017 together. Spending is in line with savings, with the business programs using up more than 50% of the budget given its contribution to savings.

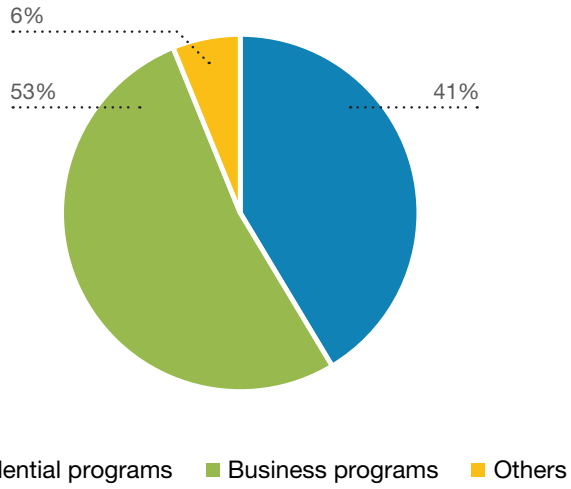


Figure C.9. CFF Spending by program portfolio 2016-2017.

Source: Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province Wide Progress".

Figure C.10 presents the individual programs that had the highest spending associated with them in 2016 and 2017 together. The spending numbers generally align with the electricity savings numbers in Figure C.3, which is expected.

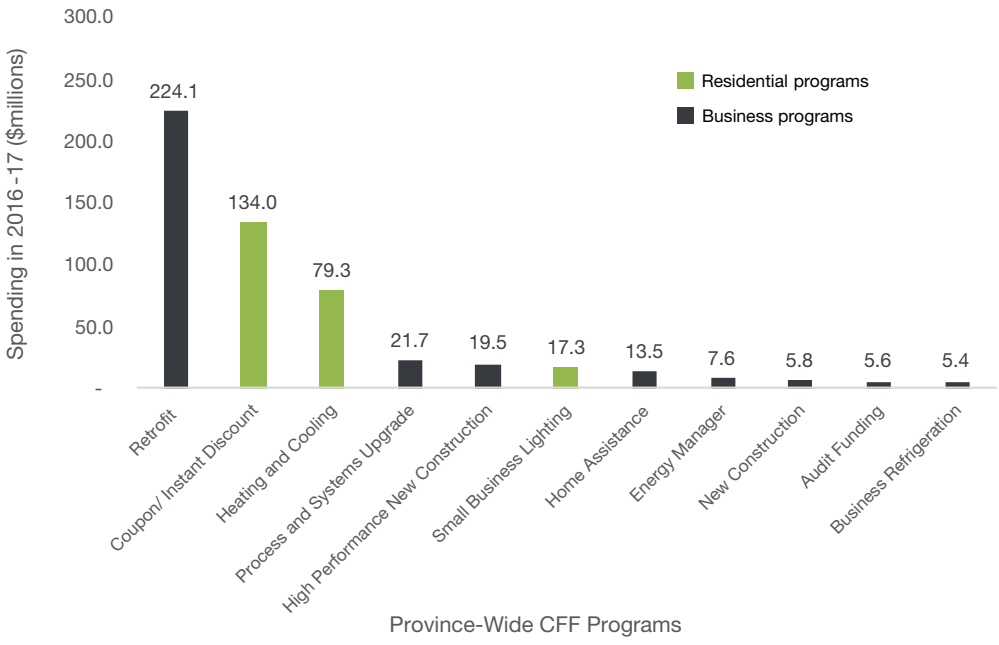


Figure C.10. Province-wide programs with the highest spending in 2016-17.

Note: The Instant Discount Program replaced the Coupon Program mid-2017.

Source: Independent Electricity System Operator, 2016 Annual Verified Local Distribution Company Conservation and Demand Management Program Results Report (Toronto: IESO, March 2018 at16, Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab "Province Wide Progress".

Province-wide, the CFF budget is expected to be sufficient to achieve the 2020 target, and to be sufficient to meet customer demand for existing conservation programs through 2020 (in other words, programs would not need to be shut down early due to lack of budget). However, because budgets are assigned individually to each LDC, some LDCs who have been very successful (and thus have paid out larger incentives to participating customers) may run out of funds before the end of 2020. This issue was raised in the Mid-Term Review (see **Chapter 2** of this report) and the IESO and LDCs are looking at how to reallocate budgets to address this concern.

C.6 Program cost-effectiveness

Except for the Home Assistance Program, all province-wide conservation programs are required to be cost-effective to be eligible for delivery in the province. Programs have to pass two separate cost-effectiveness tests, the Total Resource Cost (TRC) and the Program Administrator Cost (PAC), which compare lifetime costs of the programs from two different angles.[128] For both those tests, a ratio of greater than 1 indicates that the benefits from delivering that program are higher than the associated costs and therefore the program is beneficial for the province (TRC test), and for electricity ratepayers (PAC test).

One or more programs can be cost-ineffective if other cost-effective programs add up to bring the portfolio to a cost-effective ratio greater than 1.

Under the CFF, the entire program portfolio of each LDC has to be cost-effective, so one or more programs can be cost-ineffective if other cost-effective programs add up to bring the portfolio to a cost-effective ratio greater than 1.[129] In the CFF, the TRC also includes a 15% adder to include non-energy benefits such greenhouse gas reductions. As discussed in **Chapter 2**, the IESO is working on updating the cost-effectiveness calculations and the TRC adder to more accurately measure and value greenhouse gas emissions reductions, non-energy benefits, and avoided electricity supply costs. These updates were not applied to the evaluation of 2017 results.

Table C.7 lists cost-effectiveness of the various program portfolios under CFF from 2015 to 2017. Also shown is the levelized cost of delivery – how much electricity ratepayers pay for each unit of electricity saved.

Table C.7. Cost-effectiveness of province-wide conservation programs for 2015, 2016 and 2017.

Program	Total Resource Cost Test (benefit:cost Ratio)			Program Administrator Cost Test (benefit:cost Ratio)			Levelized Cost of Delivery (c/kWh)		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
Residential									
Coupons	11.21	18.56	23.23	2.39	4.67	5.30	2.35	1.23	1.13
Heating and Cooling	1.8	1.36	1.27	2.17	2.05	2.5	6.31	5.05	4.3
New Construction	1.26	0.27	0.34	1.88	0.61	0.78	4.21	14.08	13.63
Instant Discount (launched mid-2017)	n/a	n/a	14.95	n/a	n/a	10.46	n/a	n/a	0.59
Residental portfolio	3.59	4.94	7.27	2.2	3.4	5.37	3.63	1.92	1.22
Home Assistance	1.01	0.94	0.77	0.88	0.81	0.67	8.87	7.75	9.54
Business and Industrial									
Audit Funding	1.07	2.04	2.44	1.5	0.59	3.22	3.72	10.97	1.62
Retrofit	1.04	1.15	1.26	2.68	3.07	4.14	2.4	2.14	1.86
Small Business Lighting	0.77	1.06	2.07	0.7	1.11	2.35	10.65	6.93	3.65
High Performance New Construction	2.27	3.44	3.07	2.51	6.13	5.94	3.67	1.73	1.44
Existing Building Commissioning	0.21	1.37	0.63	0.18	1.19	0.46	36.04	4.15	12.52
Business Refrigeration	n/a	n/a	1.69	n/a	n/a	1.47	n/a	n/a	4.96
Business portfolio	1.05	1.23	1.45	2.28	3.02	3.99	3.5	2.24	1.94
Process and Systems Upgrade	0.85	0.88	0.54	1.2	1.95	1.61	5.25	0.04	5.13
Energy Managers	0.72	2.57	0.89	1.52	7.21	2.66	4.7	0.01	2.4
Monitoring and Targeting	0.08	n/a	n/a	0.08	n/a	n/a	48.25	n/a	n/a
Industrial portfolio	0.82	1.2	0.6	1.23	2.6	1.75	5.2	3	4.48
Total	**1.29**	**1.96**	**2.54**	**1.99**	**2.93**	**4.07**	**3.5**	**2.27**	**1.75**

Source: Independent Electricity System Operator, 2016 Annual Verified Local Distribution Company Conservation and Demand Management Program Results Report (Toronto: IESO, March 2018 at 14; , Independent Electricity System Operator, information provided to the ECO (15 January 2019); "2017 Evaluation Reports", online: Independent Electricity System Operator <www.ieso.ca/en/Sector-Participants/Conservation-Delivery-and-Tools/Evaluation-Measurement-and-Verification> [Accessed 8 February 2019}.

The table shows that overall, the CFF remains cost-effective in terms of the PAC and the TRC. Since the first year of the program, cost-effectiveness has improved on all counts. Electricity conservation programs delivered more than two dollars of benefits for every dollar spent in 2017, as the TRC improved from 1.29 to 2.54 between 2015 and 2017; while the PAC, which dropped slightly in 2015 compared to the 2011-2014 CDM Framework[130], has improved from 1.99 to 4.07.

Cost-effectiveness has improved on all counts.

While the improvement in the overall cost-effectiveness can be attributed to the ramp up of programs under CFF in 2016, the ECO notes that one of the main factors affecting the cost-effectiveness numbers is the high TRC and PAC of the Coupon Program. The TRC from the Coupon Program has been in the double-digits and the PAC has almost doubled within one year. The TRC and PAC values are affected by the higher electricity savings of these programs in 2016 and 2017, discussed earlier. The cost-effectiveness is also very high, due to the lower per-unit incentives paid to customers (for PAC calculations), and the long lifetime of LEDs. Without the high cost-effectiveness numbers of the Coupon Program, the Residential portfolio would have a TRC of 1.28 and a PAC of 1.97 in 2016, still positive, but significantly lower than the portfolio results with the Coupon Program included.[131]

Most of the business programs saw an improvement in cost-effectiveness in 2016, with some of the significant changes highlighted below:

- Retrofit, which is the most successful CFF program to date, remains cost effective in all measures. Despite its success, the program has seen falling participation since 2015, especially in smaller projects.[132] This has been flagged by LDCs as the low-hanging fruits run out. While participation has fallen overall since 2015, energy savings have increased because of larger projects (over 150 MWh).[133]
- The Small Business Lighting Program has seen considerable improvements in cost-effectiveness since 2015. The program also saw a 212% increase in participation in 2017.[134]
- The Business Refrigeration Program's cost-effectiveness numbers were driven by ECM motors, which suggests that the program should continue focusing on that measure.[135]
- The Audit Funding program saw improved cost-effectiveness numbers because of a large increase in per audit energy savings and increased program participation.[136]
- The New Construction Program on the residential portfolio was not cost-effective under TRC or PAC in 2016 mainly because of reduced participation under CFF as LDCs have allocated smaller budgets to this program. In addition, based on current market baseline, the current program measures also delivered lower per-unit savings.[137] Levelized unit electricity cost (LUEC) numbers increased because program costs only decreased 13% from 2015 but net verified savings decreased 74% during the same time.[138]
- The Existing Building Commissioning Program saw significant improvements in TRC, PAC and LUEC in 2016 due to lower reported program administration costs. Given the long project cycles for the Existing Building Commissioning Program, several projects were initiated under the 2011-2014 legacy framework that would not have completed by December 31, 2015. As a result, these projects continued into the CFF through the Extension Agreement mechanism.[139]
- The Process and Systems Upgrade program continued to be cost-ineffective at the TRC level, specifically for the fact that it has the highest free ridership at an average of 22%.[140] This is primarily because large customers have indicated that they would have undertaken large BMG projects regardless of program incentives being available.[141]

- The M&T Program did not have any projects completed in 2016 because of its longer completion and evaluation time.[142]

The levelized cost of delivery improved significantly from 3.5 c/kWh in 2015 to 1.75 c/kWh in 2017 (this value is from the PAC perspective; the levelized cost from the TRC perspective would be somewhat higher). This cost of saving a unit of electricity can be compared to the cost of supplying a unit of electricity from generation, which is much higher (11.5 c/kWh[143]). This highlights that the value of conservation to the province compared to generation has improved even more. Conservation still remains the most cost-effective form of meeting Ontario's electricity needs, especially at times of high demand. This is discussed in more detail in **Chapter 2** of this report.

Conservation still remains the most cost-effective form of meeting Ontario's electricity needs, especially at times of high demand.

Table C.8 lists the 2017 cost-effectiveness of programs that are not LDC-delivered, such as the Industrial Accelerator Program and the IESO's centrally delivered programs.

Table C.8. 2017 Cost-Effectiveness of non-LDC programs.

Program	Total Resource Cost	Program Administrator Cost	Levelized Cost of Delivery (c/kWh)
Industrial Accelerator Program	3.72	3.22	2.16
Energy Performance Program	1.67	3.96	1.08
Whole Home Program	0.55	0.66	11.21

Note: Whole Home Program cost-effectiveness was calculated over a 13-month period, from June 2017 through to end of June 2018.

Source: Independent Electricity System Operator, 2017 Report on Energy Efficiency Activities (Toronto: IESO, December 2018) at 8; Independent Electricity System Operator, information provided to the ECO (15 January 2019).

Combining the results of all conservation programs except demand response, 2017 programs had a TRC ratio of 2.54, a PAC ratio of 3.88, and a levelized unit cost of 1.83 cents per kilowatt-hour.[144]

Demand response initiatives are not subject to formal cost-effectiveness screening, however, the cost that IESO has been paying for DR has been steadily dropping, with the shift to a market auction. The IESO launched its first DR auction in December 2015, where DR was procured for the summer commitment period (May-October 2016) and the winter commitment period (November 2016-April 2017). A subsequent auction was held in December of 2016. The clearing price for the 2015 auction was 11% less than the historical contract cost from the DR 3 program, and subsequent auctions have seen falling prices. The average price in the most recent (2018) auction was 43% lower than the first auction in 2015.[145]

Endnotes

1. Conservation programs are funded through the Global Adjustment charge, while demand response initiatives are funded through Wholesale Market Service charges.
2. Independent Electricity System Operator, 2017 Report on Energy Efficiency Activities (Toronto: IESO, December 2018) at 6.
3. "IESO 2017 Year End Data", Independent Electricity System Operator <www.ieso.ca/Corporate-IESO/Media/Year-End-Data/2017>. [Accessed 8 February 2019]
4. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018) at Tab: Province Wide Progress; Independent Electricity System Operator, information provided to the ECO (19 February 2019).
5. "IESO 2017 Year End Data", Independent Electricity System Operator <www.ieso.ca/Corporate-IESO/Media/Year-End-Data/2017>. [Accessed 8 February 2019]
6. Based on the number of LDCs whose results the IESO reported at the end of 2017. This number will decrease to 67 with the merger of St Thomas Energy and Entegrus.
7. Directive from the Ontario Minister of Energy to the Ontario Power Authority, re: 2015-2020 Conservation First Framework (March 31, 2014).
8. For a comparison between the 2015-2020 Conservation First Framework and the 2011-2014 Conservation and Demand Management Framework, see Environmental Commissioner of Ontario, Every Joule Counts: Ontario's Energy Use and Conservation Year in Review (Toronto: ECO, August 2017) at 82.
9. While the original target was 7 TWh, it was amended in 2017 to add 0.4 TWh from the IAP target.
10. Directive from the Ontario Minister of Energy to the Ontario Power Authority, re: 2015-2020 Conservation First Framework (March 31, 2014).
11. Independent Electricity System Operator, "Target and Budget Allocation Methodology" (presentation, 16 December 2014) slide 15, online <www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/LDC-toolkit/LDC-Target-and-Budget-Allocation-Methodology-Summary-20141216.pdf?la=en>.
12. Directive from the Ontario Minister of Energy to the Ontario Energy Board re: 2015-2020 Conservation First Framework (March 31, 2014).
13. Directive from the Ontario Minister of Energy to the Independent Electricity System Operator re: 2015-2020 Conservation First Framework, and Delivery of Programs under the Conservation First Framework and the Industrial Accelerator Program (December 16, 2016).
14. Independent Electricity System Operator, "Target and Budget Allocation Methodology" (presentation, 16 December 2014) slide 18, online <www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/LDC-toolkit/LDC-Target-and-Budget-Allocation-Methodology-Summary-20141216.pdf?la=en>.
15. Programs are approved by the IESO and the "duplication test" rules have been amended to encourage collaboration and local/regional program applications.
16. 2015-2020 IESO-LDC Energy Conservation Agreement (2014), Section 4.5.
17. Ibid, Section 5.4.
18. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Report Summary".
19. Originally reported results were 2015 persistent net energy savings of 1117 GWh and 2016 persistent net energy savings of 1154 GWh.
20. Directive from the Ontario Minister of Energy to the Independent Electricity System Operator re: Reallocation of Targets from the Industrial Accelerator Program to 2015-2020 Conservation First Framework (February 8, 2018).
21. Independent Electricity System Operator, information provided to the ECO (8 August 2018).
22. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Report Summary".
23. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".
24. Independent Electricity System Operator, 2016 Annual Verified Local Distribution Company Conservation and Demand Management Program Results Report (Toronto: IESO, March 2018) at 20.
25. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".
26. Independent Electricity System Operator, information provided to the ECO (7 August 2018). One of the main factors that led to this change was the high administrative effort and cost associated with running and managing the program for the IESO, the fulfillment agent and for the retailers. There was also evidence of customer confusion with both the IESO and the LDC providing coupons by mail and online and customers were also required to print coupons to use in-store which was a barrier to participation.
27. Independent Electricity System Operator, Evaluation of 2017 Save On Energy Residential Province Wide Programs by Cadmus (Toronto: IESO, November 2018) at 4. PAC for the Coupon program is 5.30 vs. 10.46 for the Instant Discount program.
28. Independent Electricity System Operator, 2017 Report on Energy-Efficiency Activities (Toronto: IESO, December 2018) at 4.
29. Independent Electricity System Operator, Volume 1: Final PY2016 Evaluation of Consumer Reports by Cadmus (Toronto: IESO, October 2017) at 11-12.
30. Ibid at 58.
31. Environmental Commissioner of Ontario, Restoring Balance: A Review of the First Three Years of the Green Energy Act (Toronto: ECO, June 2012) at 14.
32. Independent Electricity System Operator, 2017 Report on Energy-Efficiency Activities (Toronto: IESO, December 2018) at 59.
33. Independent Electricity System Operator, Volume 1: Final PY2016 Evaluation of Consumer Reports by Cadmus (Toronto: IESO, October 2017) at 20.
34. Independent Electricity System Operator, Evaluation of 2017 Save on Energy Residential Province Wide Programs by Cadmus (Toronto: IESO, November 2018) at B-164.
35. Ibid at Appendix C.
36. Ibid at C-204.
37. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".

38. Independent Electricity System Operator, information provided to the ECO (15 January 2019).
39. Independent Electricity System Operator, information provided to the ECO (8 August 2018).
40. Independent Electricity System Operator, Volume 1: Final PY2016 Evaluation of Consumer Reports by Cadmus (Toronto: IESO, October 2017) at 13.
41. Independent Electricity System Operator, 2016 Annual Verified Local Distribution Company Conservation and Demand Management Program Results Report (Toronto: IESO, March 2018) at 20 ; Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".
42. Independent Electricity System Operator, Evaluation of 2017 Business Programs by Nexant (Toronto: IESO, November 2018) at 26.
43. Ibid.
44. Independent Electricity System Operator, information provided to the ECO (8 August 2018).
45. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".
46. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".
47. Independent Electricity System Operator, Evaluation of 2017 Business Programs by Nexant (Toronto: IESO, November 2018) at 6.
48. Ibid.
49. Ibid at 7.
50. Ibid.
51. Independent Electricity System Operator, Program year 2017 Evaluation Report: Conservation First Framework Industrial Programs (Toronto: IESO, November 2018) at 34.
52. For more information about CHP projects, please see The Environmental Commissioner of Ontario, Every Joule Counts: Ontario's Energy Use and Conservation Year in Review (Toronto: ECO, August 2017) at 91.
53. Directive from the Ontario Minister of Energy to the Independent Electricity System Operator re: Amendments to Ministerial Directions Arising from the Long-Term Energy Plan 2017 (26 October 2017).
54. Independent Electricity System Operator, Program year 2017 Evaluation Report: Conservation First Framework Industrial Programs (Toronto: IESO, November 2018) at 74.
55. Various LDCs, information provided to the ECO (June- August 2018).
56. Independent Electricity System Operator, Program year 2017 Evaluation Report: Conservation First Framework Industrial Programs (Toronto: IESO, November 2018) at 75.
57. Independent Electricity System Operator, Program year 2017 Evaluation Report: Conservation First Framework Industrial Programs (Toronto: IESO, November 2018) at 76.
58. Independent Electricity System Operator, information provided to the ECO (15 January 2019).
59. Independent Electricity System Operator, 2017 Report on Energy-Efficiency Activities (Toronto: IESO, December 2018) at 4. The IESO Conservation Fund, which has an annual budget of $9.5 million, has been running since 2005 to support innovation energy projects across the province. To date, it has funded over 200 projects run by LDCs, technology companies, consulting firms, universities and colleges and the public sector. Funds are offered to initiatives that are piloting innovating conservation technologies to try and bring about large-scale market transformation.
60. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".
61. Ibid.
62. CustomerFirst, information provided to the ECO (15 June 2018).
63. Independent Electricity System Operator, Home Energy Assessment and Retrofit Pilot Impact and Process Evaluation by Cadmus (Toronto: IESO, November 2018) at 1.
64. Ibid.
65. Ibid at 3.
66. Ibid at 19
67. Ibid at 6.
68. Ibid at 39.
69. Ibid at 35-37.
70. Directive from the Ontario Minister of Energy to the Independent Electricity System Operator re: Delivery of Conservation and Demand Management Programs to the Low-Income Customer Segment (4 August 2017)
71. Directive from the Ontario Minister of Energy to the Independent Electricity System Operator re: Upgrades to Existing Renewable Projects, Conservation First Framework and Support Programs (10 June 2016.
72. Ibid.
73. Independent Electricity System Operator, "Engagement Webinar: Multi- Distributor Customer Pay-for-Performance Program Draft Design"(presentation 21 July 2016) slide 5, online <www.ieso.ca/-/media/Files/IESO/Document-Library/engage/p4p/P4P-20160715-Program-Design.pdf?la=en >.
74. Ibid slide 6.
75. Independent Electricity System Operator, information provided to the ECO (19 February 2019).
76. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".
77. Independent Electricity System Operator, information provided to the ECO (15 January 2019).
78. Directive from the Ontario Minister of Energy to the Independent Electricity System Operator re: 2015-2020 Conservation First Framework, and the Delivery of Programs under the Conservation First Framework and the Industrial Accelerator Program (16 December 2016).
79. Independent Electricity System Operator, Evaluation of PY2017 Home Assistance Program by Cadmus (Toronto: IESO, November 2018) at 12.
80. Ibid.
81. Ibid at 50.

82. Directive from the Ontario Minister of Energy to the Independent Electricity System Operator re: 2015-2020 Conservation First Framework and Partnering with the Green Ontario Fund; Delivery of Conservation and Demand Management Programs to the Low-Income Customer Segment (4 August 2017).

83. Ibid.

84. Independent Electricity System Operator, information provided to ECO (8 August 2018).

85. Ibid.

86. Various LDCs, information provided to the ECO (June- August 2018).

87. Independent Electricity System Operator, information provided to ECO (15 January 2019.

88. Ibid.

89. Independent Electricity System Operator, 2017 Final Verified Annual LDC CDM Program Results Report (Toronto: IESO, September 2018), tab "Province Wide Progress".

90. Six LDCs have not achieved 50% of their targets but will be receiving MTIs because they are part of a joint plan that has achieved 50% or more of the aggregated target under the joint plan or because they have achieved 50% or more of their achievable potential less any target allocated to pay-for-performance. Three additional LDCs have achieved 50% of their targets but have postponed MTI payments until after 2018 final results are verified (Source: Independent Electricity System Operator, information provided to the ECO (19 February 2019)).

91. Independent Electricity System Operator, 2016 Annual Verified Local Distribution Company Conservation and Demand Management Program Results Report (Toronto: IESO, March 2018) at 20

92. As of July 1 2018, CHP is no longer eligible under CFF.

93. Independent Electricity System Operator, 2017 Report on Energy-Efficiency Activities (Toronto: IESO, December 2018) at 8.

94. Independent Electricity System Operator "Industrial Accelerator Program: Overview of Proposed IAP Changes" (presentation, 19 November 2018), online <www.ieso.ca/-/media/Files/IESO/Document-Library/IAP/Overview-of-Proposed-IAP-Changes-20181119.pdf?la=en>.

95. Independent Electricity System Operator, information provided to the ECO (8 August 2018).

96. Independent Electricity System Operator, information provided to the ECO (15 January 2019).

97. For more information on the cancellation of the peaksaver PLUS program, see the Environmental Commisssioner of Ontario, Every Joule Counts, Ontario's Energy Use and Conservation Year in Review (Toronto: ECO, August 2018) at 100.

98. Interested DR providers have to apply to participate in advance of an auction period and meet certain qualifications; including meeting certain capacity thresholds and submitting a DR auction deposit; before being accepted. The IESO processes applications to determine clearing prices and quantities and then publish post-auction reports confirming the participants for the next auction. There are two commitment windows for each annual auction, summer (May 1 to October 31) and winter (Nov 1 to April 30) and participants can apply to one or both (separate applications) depending on their abilities. For more information on how this process is set up, please see Independent Electricity System Operator, Market Manual 12, Demand Response Auction, Issue 6.0 (Toronto: IESO, March 2017) at 12-18

99. Independent Electricity System Operator, information provided to the ECO (15 January 2019).

100. Independent Electricity System Operator, information provided to the ECO (8 August 2018). Since the IESO cannot track installation at contributor level, there is no confirmation at this point in time if the devices are participating in DR auction process.

101. Independent Electricity System Operator, information provided to the ECO (19 February 2019).

102. Ibid.

103. Independent Electricity System Operator, "Meeting Ontario's Capacity Needs after 2020" (presentation at IESO Stakeholder Advisory Committee, 14 February 2019) at 2.

104. Ibid at 3.

105. For more information, see Environmental Commissioner of Ontario, Making Connections: Straight Talk about Electricity in Ontario, 2018 Energy Conservation Progress Report, Volume One (Toronto: ECO, April 2018) at 270.

106. The IESO is currently engaging DR stakeholders through a number of forums such as the DR Working Group, the Market Renewal Working Group and the Incremental Capacity Auction Stakeholder Engagement process. The DR Working Group is working on near-term matters aligned with the Market Renewal Initiative, such as improving flexibility and availability of hourly demand response. All DR stakeholders are active in developing the respective high-level market designs that will all become part of the entire Market Renewal initiative. The IESO expects that the high-level designs relevant to DR will be completed by Q3 of 2018 to Q2 of 2019.

107. During the evaluation of the peaksaver PLUS program, the IESO would conduct a randomized control trial where two random samples would be selected across the province and one would see an activation while the other would not. Load impacts differences between the two groups would be used for the program's evaluation. For more information, see Independent Electricity System Operator, peaksaver PLUS Program 2014 Load Impact Evaluation by Nexant (Toronto: IESO, August 2015) at 6; Independent Electricity System Operator, information provided to the ECO (15 January 2019).

108. Estimated peak demand reduction capacity based on program evaluation. Actual demand response provided when called in September 2017 was slightly higher (175 MW).

109. "Heatwave continues this week as Toronto sets weather record", BlogTO: online <www.blogto.com/city/2017/09/heatwave-toronto-weather-record-september/>. [Accessed 11 February 2019]

110. "Global Adjustment and Peak Demand Factor", Independent Electricity System Operator: online <www.ieso.ca/en/Sector-Participants/Settlements/Global-Adjustment-and-Peak-Demand-Factor>. [Accessed 11 February 2019]

111. Ibid

112. Ibid.

113. Independent Electricity System Operator, information provided to the ECO (31 March 2018).

114. Independent Electricity System Operator, information provided to the ECO (8 August 2018).

115. Independent Electricity System Operator, "Target and Budget Allocation Methodology: Conservation First Framework LDC Toolkit Final V2" (IESO LDC toolkit, 16 December 2014), slide 10. In 2017, the budgets were amended to $2.42 billion for CFF and $0.28 for IAP when targets were moved.

116. Independent Electricity System Operator, information provided to the ECO (19 February 2019).

Spending (millions $)	2016	2017	Total
CFF LDC Spending	206.28	363.78	570.06
IESO Central Services	27.12	42.18	69.3
Legacy Framework spending	90.15	0	90.15
Mid-Term Incentive	0	67.6	67.6
Industrial Accelerator Program	22.5	16.7	39.2
Demand Response	45.4	50.8	96.2
Total	391.45	541.06	932.51

117. According to Independent Electricity System Operator, information provided to the ECO (8 August 2018), Global Adjustment recovery for conservation spending in 2016 is $467.1 million. Total GA in 2016 was $12.3 billion. According to Independent Electricity System Operator, information provided to the ECO (15 January 2019), recovery for conservation spending in 2017 was $364 million, total GA in 2017 was $11.2 billion. The amounts recovered through the Global Adjustment each year do not exactly match conservation spending for the year, due to a lag time of several months.

118. Independent Electricity System Operator, information provided to the ECO (8 August 2018).

119. See table in endnote 115. CFF spending includes CFF LDC spending, IESO central services, legacy framework spending and Mid-Term Incentives. Independent Electricity System Operator, information provided to the ECO (8 August 2018 and 15 January 2019).

120. For more information on the different types of programs, see Environmental Commissioner of Ontario, Every Joule Counts: Ontario's Energy Use and Conservation Year in Review (Toronto: ECO, August 2017) at 85.

121. 2015-2020 IESO-LDC Energy Conservation Agreement (2014), section 4.2c. Also see endnote 91.

122. Independent Electricity System Operator, "Target and Budget Allocation Methodology: Conservation First Framework LDC Toolkit Final V2" (IESO LDC toolkit, 16 December 2014), slide 10.

123. Independent Electricity System Operator, information provided to the ECO (15 January 2019)

124. See table in endnote 115.

125. For a further breakdown of the spending categories for the legacy progams, see Independent Electricity System Operator, 2016 Annual Verified Local Distribution Company Conservation and Demand Management Program Results Report (Toronto: IESO, March 2018) at 13. According to a response from the IESO to an ECO information request, there is a notable proportion of conservation spending in 2016 from legacy (pre-CFF) funds due to the Extension Agreements that LDCs were permitted to undertake in order to fund certain projects originating from the legacy framework, and provide a smooth transition for customers between the two frameworks. The Extension Agreements were developed as an option for LDCs to fund some projects that originated under the 2011-2014 framework, and were not yet completed or expected to have been completed by December 31, 2015.

126. Independent Electricity System Operator, information provided to the ECO (15 January 2019)

127.

Category of spending	$
Participant Incentives	392,698,843.00
LDC Administrative Expenses	165,267,367.00
IESO value added services	12,088,732.00
Total	570,054,942.00

128. The TRC looks at the costs and benefits that accrue to society, including additional costs paid by customers and non-energy benefits. The PAC reviews costs and benefits from the viewpoint of the program administrator.

129. Independent Electricity System Operator, CDM Plan Submission and Review Criteria Rules, Final Version 3.0 (Toronto: IESO July 2017) at 4.

130. Environmental Commisssioner of Ontario, Every Joule Counts, Ontario's Energy Use and Conservation Year in Review (Toronto: ECO, August 2018) at 98.

131. Independent Electricity System Operator, Evaluation of 2017 Save On Energy Residential Province Wide Programs by Cadmus (Toronto: IESO, November 2018)at 143.

132. Independent Electricity System Operator, Evaluation of 2017 Business Programs by Nexant and NMR Group Inc. (Toronto: IESO, November 2018) at 4.

133. Ibid

134. Ibid at 6.

135. Ibid at 7.

136. Ibid.

137. Independent Electricity System Operator, Evaluation of 2017 Save On Energy Residential Province Wide Programs by Cadmus (Toronto: IESO, November 2018) at 140 and 144.

138. Ibid page 144.

139. Independent Electricity System Operator, information provided to the ECO (8 August 2018).

140. Independent Electricity System Operator, Program Year 2017 Evaluation Report: Conservation First Framework Industrial Programs by Ecometric (Toronto: IESO, November 2018) at 9.

141. Ibid at 9.

142. Ibid at 76.

143. "2018 Electricity Data", online: Independent Electricity System Operator <www.ieso.ca/en/Corporate-IESO/Media/Year-End-Data>. [Accessed 11 February 2019]

144. Independent Electricity System Operator, information provided to the ECO (15 January 2019). Important to note that not all programs were evaluated for the length of the entire year, i.e., from January 1 2017 to December 31, 2017.

145. "IESO announces Results of Demand Response Auction", online: Independent Electricity System Operator <www.ieso.ca/en/Sector-Participants/IESO-News/2018/12/IESO-Announces-Results-of-Demand-Response-Auction>. [Accessed 11 February 2019]

Appendix D: Natural gas conservation program results

Abstract

This chapter reviews the most recent verified results (from 2016) of one of Ontario's most important natural gas conservation policy tools: utility-run and natural gas ratepayer-funded conservation programs (also known as demand-side management).

2016 was a significant year for natural gas conservation in Ontario because it was the first full year of a new demand-side management framework, which provided utilities with significantly higher budgets. Natural gas spending in 2016 was about 50% higher than in 2015. Most of this increase in spending was targeted at customers historically underserved by conservation programs: residential customers, small businesses and low-income residents. This led to new programs, greater participation and more energy savings from these sectors.

However, taken as a whole, net natural gas savings (for programs evaluated using this metric) in 2016 were reported to be 30% lower than in 2015. There are two main reasons for this:

- A change in evaluation inputs (based on a new program evaluation) took effect in 2016. This resulted in the net energy savings attributed to the utilities' most cost-effective and fruitful conservation programs (those for large industrial and commercial customers) being reduced by more than half. If the same evaluation inputs were used for both years, overall natural gas savings would have been 7% higher in 2016 than in 2015.

- The increase in conservation spending was primarily directed at smaller, harder-to-reach customer segments. These conservation programs typically require more spending per unit of energy saved, compared with programs for larger customers. It also takes time for new programs to get established and become effective.

Natural gas programs remain highly cost-effective, saving Ontarians almost three dollars for every dollar spent in 2016. Since 2007, natural gas conservation programs have reduced gas use by utility customers to approximately 7% lower than it would otherwise be, and annual greenhouse gas emissions are 3 megatonnes lower (2% of Ontario's overall emissions).

The verification process for energy conservation results is getting more stringent. The energy efficiency baseline is getting higher. And, conservation programs are becoming more accessible to more customers. As a result of these trends, incremental spending on natural gas conservation continues to deliver social, economic and climate benefits.

Contents

D.1 Introduction

Ontario's two large natural gas utilities, Enbridge Gas Distribution and Union Gas, have offered conservation programs to their customers since the 1990s.[1] Conservation programs (also known as demand-side management, or DSM) are offered to all segments of the customer base – residential, commercial, industrial and low-income customers. The budget for these conservation programs comes from natural gas customers, and the gas utilities are eligible for performance incentives depending on their results against energy conservation targets.

A six-year policy framework established by the Ontario Energy Board (OEB) covers the period between 2015 and 2020, providing guidance on program mix, budgets, and targets, among other details.[2] This matches the timeframe of the framework for electricity conservation programs, discussed in **Appendix C**. The new framework greatly increased the combined conservation budgets of the gas utilities, from roughly $65 million per year (combined) in 2015 to $130 million per year by 2018, still far less than the approximately $400 million per year spent on electricity conservation.

As was the case for electricity conservation programs, 2015 ended up being a transition year between natural gas conservation frameworks. 2015 was supposed to be the first year of the 2015-2020 Natural Gas DSM Framework. But because the new framework was not finalized until December 2014, the utilities were ordered to continue to run programs and budgets in 2015 according to the previous 2012-2014 Framework.[3]

2016 was therefore the first year for utilities to implement the new framework, including establishing new or expanded programs and accessing the increased conservation budgets.

2016 was the first year for utilities to implement the new framework, including accessing the increased conservation budgets.

A program evaluation in 2015 led to significant changes to the free-ridership rates for some utility conservation programs (this is discussed in more detail in section D.3.3). It has been a source of dispute as to how these evaluation findings should be used to adjust reported results and natural gas targets – this issue has been settled by the OEB for 2015, but not yet for 2016.

Unless otherwise stated, in this appendix the ECO reports the following numerical results:

- net energy savings for 2015 results based on old free-ridership values[4]
- net energy savings for 2016 results based on updated free-ridership values, and
- 2016 targets as specified in the OEB's decision on the 2015-2020 DSM Framework and used in the 2016 DSM Evaluation Report (i.e., not adjusted downwards).[5]

This appendix reviews:

- overall energy savings and emissions reductions from utility programs
- details on program spending and cost-effectiveness, including how the additional 2016 budget was spent, and why it did not translate to proportionally more savings
- utility performance against their conservation targets, and
- key developments for specific programs.

D.2 Natural gas savings from conservation programs

D.2.1 Savings from 2016 programs

The total amount of avoided natural gas use is the primary metric for measuring the success of most utility-run natural gas conservation programs in Ontario. (A small percentage of conservation programs are dedicated to achieving other important ends, for example bringing about a future market shift or addressing equity issues. These are primarily assessed on other metrics, like number of participants or units built.)[6]

The total amount of avoided natural gas use is the primary metric for success.

Gas savings can be reported as **cumulative savings** (natural gas savings over the lifetime of a conservation measure), or **annual savings** (reduced use in the first year of a conservation measure).[7] For example, a furnace replacement might deliver annual savings of 500 cubic metres (m^3) of natural gas per year for 15 years, giving cumulative savings of 7,500 m^3. Utility performance targets are generally based on cumulative savings. The choice of cumulative (lifetime) savings rewards utilities for pursuing longer-lasting conservation measures; for example, building envelope improvements are assumed to deliver 20 to 25 years of savings[8] as compared to low-flow shower heads which are assumed to have a 10-year life.[9]

The net cumulative natural gas savings achieved in each year of conservation program activity from 2012 to 2016 by Enbridge and Union Gas are shown in Figure D.1.

In terms of net cumulative natural gas savings, 2016 saw a 30% drop in reported savings, despite a budget increase, due primarily to an update in evaluation inputs (if the same evaluation inputs were used for both years, overall natural gas savings in 2016 would have been 7% higher than in 2015).[10] The change in evaluation inputs, and the reasons why the budget increase did not lead to more savings, are explored in section D.3.

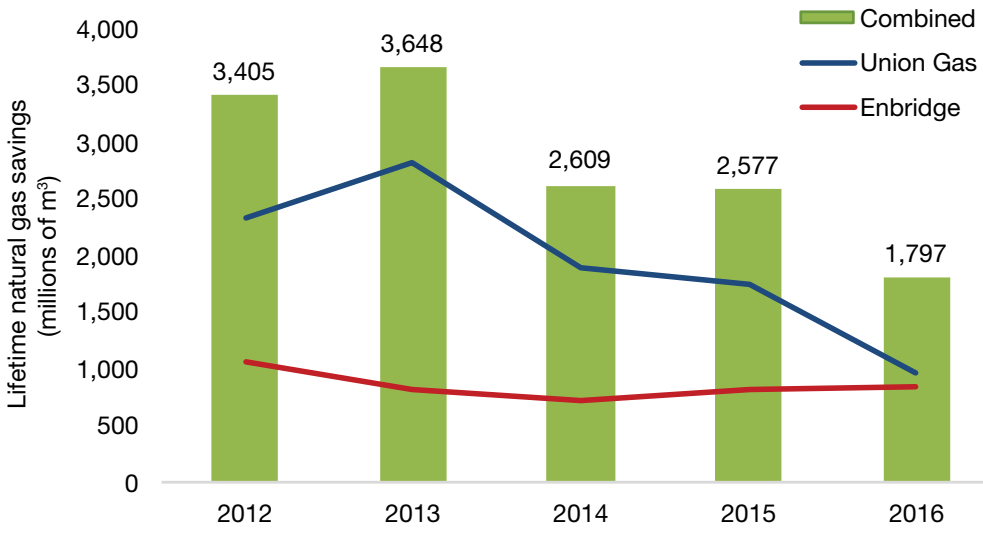


Figure D.1. Net cumulative natural gas savings due to programs implemented in each year for Union Gas, Enbridge, and both combined (2012-2016).

Note: 2015 results do not apply updated net-to-gross adjustments for custom programs, as per OEB decisions EB-2017-0324 and EB-2017-0323.

Source: Enbridge and Union Gas' DSM final annual reports, from 2012-2016.

D.2.2 Savings impact from multiple years of program activity

The annual net savings from 2016 gas conservation programs represented roughly 0.5% of Enbridge's gas sales, and 0.4% of Union's gas sales.[11] This seems quite small, but because conservation projects deliver savings for many years, the impact of conservation program activity adds up over time.

In 2016, natural gas use was roughly 6% lower for Enbridge customers and 8% lower for Union Gas customers than it would have been without conservation programs, based on the combined impact of the last decade of conservation programs (see Table D.1).[12]

In 2016, natural gas use was roughly 6% lower for Enbridge customers and 8% lower for Union Gas customers than it would have been without conservation.

Table D.1. Net annual gas savings from conservation as a percentage of overall utility gas sales.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Enbridge	0.7	0.7	0.6	0.6	0.7	0.6	0.4	0.4	0.4	0.5	6%
Union	0.4	0.5	0.75	0.95	1.0	1.0	1.3	0.9	0.9	0.4	8%

Note: Percentage of gas sales excludes sales to the small number of utility customers in rate classes not eligible for conservation programs.

Source: Enbridge, 2016 DSM Annual Report (17 November 2018) at table 3.10; Union Gas, 2016 DSM Final Annual Report (30 November 2018) at table 3.10.

Figure D.2 presents an estimate of annual gas savings in 2016, based on the combined savings from the last decade of program activity. Natural gas conservation programs have reduced annual natural gas consumption by close to 1,700 million m^3. This is enough natural gas to fuel over 700,000 homes.[13]

There is not an exact one-to-one relationship between savings from conservation programs and the overall amount of natural gas used by utility customers, because other factors, such as weather and changes in the number of customers, also affect the amount of gas used. Overall, gas consumption by utility customers has dropped by almost 10% for Enbridge since 2007, and almost 2% for Union Gas.[14]

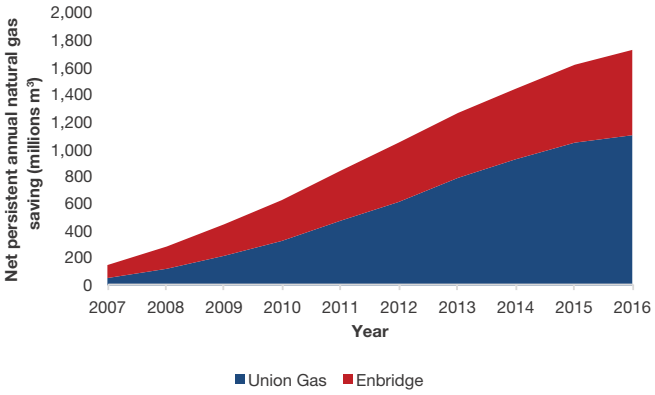


Figure D.2. Persistent net energy savings from natural gas conservation programs 2007-2016.

Source: Enbridge Gas Distribution Inc., 2016 Demand Side Management Annual Report; Union Gas, 2016 Demand Side Management Final Annual Report.

Greenhouse gas emissions reductions

Avoided natural gas use reduces air and climate pollution. Natural gas combustion emits carbon dioxide, methane and nitrous oxide into the atmosphere.

Based on the most current emissions factors used to calculate Canada's greenhouse gas (GHG) emissions to the United Nations (which itself severely underreports the impact of methane, see ECO's discussion of this issue in the 2018 Annual Energy Conservation Report, Making Connections at Q11), the annual GHG reductions due to the last decade of conservation program activity are roughly 3.2 megatonnes (Mt) carbon dioxide equivalent (CO_2e).[15] This is roughly 2% of Ontario's overall greenhouse gas emissions. Coincidentally, 3.2 Mt is also the amount of incremental emissions reductions that Ontario's draft Environment Plan intends to deliver due to an expansion of natural gas utility conservation programs.[16] How to deliver this incremental 3.2 Mt of emissions reductions is explored in more detail in **Chapter 2** of this report.

Avoided natural gas use reduces air and climate pollution.

The impact of annual GHG reductions due to conservation programs delivered between 2012 and 2016 is shown in more detail in Table D.2.

Table D.2. Greenhouse gas emissions reductions (kt CO_2e) from gas utility conservation programs (2012-2016).

	2012	2013	2014	2015	2016
Enbridge	114	91	83	93	96
Union	261	342	250	238	106
Total	**375**	**433**	**333**	**331**	**202**
Overall Ontario emissions	169,100	168,400	165,400	162,900	160,600
GHG reductions from conservation as a % of overall Ontario emissions	**0.2%**	**0.3%**	**0.2%**	**0.2%**	**0.1%**

Note: Does not include reductions in upstream emissions. The emissions factors used are those from the Intergovernmental Panel on Climate Change's Fourth Assessment Report, which means 25 for methane and 298 for nitrous oxide, with the inclusion of climate-carbon feedbacks. Canada has yet to adopt the emissions factors from the Fifth Assessment report, which are much higher for methane (34).[17]

Source: ECO calculation.[18]

D.3 Why more spending did not equal more savings

D.3.1 Program spending

In response to guidance in the new framework, utility spending on natural gas conservation increased from $68 million in 2015 to $104 million in 2016 (see Table D.3).[19]

Table D.3. Annual natural gas conservation budgets for Enbridge and Union Gas, actual spending (2014-2016) and approved budget (2017-2020).

	Annual conservation budgets (millions of dollars)						
	2014 (actual)	2015 (actual)	2016 (actual)	2017 (approved)	2018 (approved)	2019 (approved)	2020 (approved)
Enbridge	33	36	56	63	68	66	68
Union	34	32	48	59	63	63	64
Total	**$67**	**$68**	**$104**	**$122**	**$131**	**$130**	**$132**

Note: Totals may be slightly off due to rounding. Budgets do not include the maximum annual shareholder incentive of $10.45 million/utility/year.

Source: Actuals from: Enbridge, 2016 DSM Annual Report (17 November 2018) at table 3.2; Union Gas, 2016 DSM Final Annual Report (30 November 2018) at table 3.2. Approved budget from: OEB, Decision and Order EB-2015-0029/EB-2015-0049 (20 January 2016) at 56.

This spending did not translate into proportionally higher natural gas savings, primarily because:

- budget increases were primarily directed at expanded programs for harder-to-reach customers, with higher costs per unit of energy savings, and
- reported net savings from commercial and industrial programs were reduced significantly in 2016 due to an update in savings estimates, based on evaluation results, and specifically an update for free-ridership rates (see section D.3.3).

D.3.2 Increased conservation spending targeted at harder-to-reach customers

The key drivers of increased conservation spending in 2016 are shown in Table D.4.

Table D.4. Key drivers for increased natural gas conservation spending (2015 versus 2016).

	Enbridge		Union Gas	
	2015 Spending	**2016 Spending**	**2015 Spending**	**2016 Spending**
Residential programs	$9.4 million	$23.7 million	$5.5 million	$11.2 million
Low-income programs	$7.1 million	$8.7 million	$7.7 million	$10.4 million
Market transformation programs	$4.7 million	$6.4 million	Not a major cause of spending increase	
New direct install program for small commercial customers	$0	$2.4 million	Not applicable	
Commercial/industrial programs (excluding large-volume)	Not a major cause of spending increase		$11.4 million	$16.4 million

Source: Enbridge, 2015 DSM Annual Report (18 December 2017) at table ES-0; Union Gas, 2015 DSM Final Annual Report (15 December 2017) at table 4.1; Enbridge, 2016 DSM Annual Report (17 November 2018) at table ES-0; Union Gas, 2016 DSM Final Annual Report (30 November 2018) at table 4.1.

Most of the categories of increased spending in Table D.4 are focused on harder-to-reach customers: residential customers, low-income customers and small businesses (these developments are discussed on a sector-by-sector basis in section D.5). This was the result of guidance in the new framework which is aimed at making natural gas conservation programs more accessible to more customers, even if they may be more expensive to deliver per unit of savings than programs for larger commercial/industrial customers.[20]

In part this is an issue of fairness. Costs of conservation programs are spread across all customers within a rate class, whether or not they are participating, and historically, smaller customers have participated less than larger customers. While non-participants receive some benefits from conservation programs in terms of avoided greenhouse gas emissions and reduced system costs, most benefits go to participants in the form of lower energy bills. One of the criteria in setting the natural gas conservation budget for 2015-2020 was the cost impact on non-participants – capped at a $2 monthly bill impact for residential customers.[21] Increasing access to and participation in conservation programs helps address this concern and ensure more customers benefit from conservation.

The fact that incremental spending directed to harder-to-reach customers will not deliver the same level of savings as previous programs is recognized in the savings targets set for each utility, which did not increase in 2016 at the same rate as budgets.[22]

The OEB expects utility conservation performance to improve as utilities gain more experience delivering programs.

As a countervailing trend, however, the OEB expects utility conservation performance to improve as utilities gain more experience delivering programs. For this reason, targets for future years include productivity improvement factors that increase by 2% per year for all conservation programs, and 10% per year for certain categories of programs with more opportunity for improvement. These are stretch factors that are intended to promote continued efficiency in program delivery. The OEB describes this relationship between each year's target and budget as "non-linear."[23]

D.3.3 Higher free-ridership estimates (and lower net energy savings) for custom programs for commercial and industrial customers

Each year, the utilities' claimed conservation program savings are reviewed by a third-party evaluator, and, if necessary, the results are adjusted. The 2015 results were the first year of results subject to a new evaluation process led by OEB staff, who hire an expert evaluator, and receive input from an Evaluation Advisory Committee (the ECO is an observer on this committee).

A major element of the 2015 evaluation was a new study[24] conducted by the evaluator that:

- measured the accuracy of the gross energy savings reported for the utilities' custom commercial, industrial and large volume programs (this was also done in previous years); and
- converted gross energy savings to net savings, including measuring and updating the free-ridership rates (previously last updated in 2008) for these programs (i.e., what percentage of participating customers would have still undertaken the conservation projects supported by these programs, if the programs, and their supporting financial incentives and technical support, were not offered).

  n.b. Net savings, which include only savings that are directly attributable to a program's influence, are usually lower than gross savings. The free-ridership rate is the most important adjustment in converting from gross savings to net savings.[25] Program results presented in this chapter are net savings, as this measures program impact, and utility performance incentives are based on net savings.

The study found a high level of accuracy in the reported gross energy savings, assessed through methods including site visits, interviews and desk reviews of project data. Verified gross energy savings for custom programs ranged from 89-135% of the originally reported savings.[26]

However, the study found a higher level of free ridership than had previously been assumed and used in reporting results. Previous values of free-ridership date from a 2008 study – a value of 54% free-ridership was used by Union Gas for all custom programs, while Enbridge's programs used a range between 0-50%, depending on the program and sector. New estimates of free ridership based on the 2015 study range from 50-92%, depending on the program.[27]

Custom programs generally involve a representative from the utility working with commercial and industrial customers to identify and implement energy savings projects, along with related financial incentives to customers.[28] It is not surprising that these custom programs have a relatively high level of free ridership (compared to prescriptive programs for other sectors such as small businesses and low-income customers for example), because the financial incentives that utilities can offer are generally a small portion of overall project costs, customers using custom programs tend to be larger, and some (though not all) companies may have suitable technical expertise on staff to identify conservation projects without utility technical assistance.

Assessing the level of program influence on customer decision-making regarding conservation projects is not an exact science, as most decisions will involve multiple influences. The 2015 study estimated free ridership through a series of interview questions posed to participants in custom conservation programs,

regarding their motivations. An updated study of this nature was long overdue, however utilities have expressed concerns with some of the methodological choices. Utility concerns included the long delay between the timing of projects and the follow-up interviews (up to three years) and the lack of coverage of "secondary attribution" – the longer-term, indirect role of utility-customer interactions and the continued availability of technical assistance and incentives over more than a decade in encouraging companies to identify and act on conservation opportunities.[29] An updated net-to-gross study on custom commercial and institutional programs for 2018 participants is planned, but for now, the values from this 2015 study will be used.

This change in free-ridership rates has major impacts on the reported net savings for natural gas conservation programs. This is because the custom programs for Enbridge and Union's larger customers represented the lion's share of their claimed savings and came at the lowest cost per unit saved of any program in their portfolios. The adjustments would reduce overall energy savings (from the full portfolio of utility programs) by roughly 35% (Table D.5). Even with the much higher free-ridership rates (and thus lower net energy savings), the utilities' custom commercial and industrial programs remain highly cost-effective, delivering roughly three to six dollars in benefits per dollar spent.[30]

Table D.5. Potential impact of free-ridership assumptions if they were applied to 2015 net natural gas savings for utility conservation programs.

	Net cumulative natural gas savings (million m^3) – old free-ridership values	Net cumulative natural gas savings (million m^3) – updated free-ridership values	% change
Union Gas	1,750.8	1,137.8	-35%
Enbridge	826.2	539.8	-35%

Source: For savings based on old free-ridership assumptions, see: Enbridge, 2015 DSM Annual Report (18 December 2017) at table ES-0; Union Gas, 2015 DSM Final Annual Report (15 December 2017) at table 4.0. For savings based on updated free-ridership assumptions, see: DNV-GL, 2015 DSM Natural Gas Demand Side Management Annual Verification (OEB, 20 December 2017) at tables 1-1 and 1-6.

This change in free-ridership rates has major impacts on the reported net savings for natural gas conservation programs.

The change in natural gas savings also has a large impact on the performance incentives that utilities are eligible to receive as a reward for successfully reaching their targets for conservation program performance. For this reason, elements of both the 2015 and 2016 evaluations have been challenged by the utilities as part of OEB clearance applications (see the textbox "Ontario Energy Board approval of financial incentives for 2015 and 2016 results").

Ontario Energy Board approval of financial incentives for 2015 and 2016 results

The financial performance incentives natural gas utilities receive (based on performance against energy savings targets) are paid for by natural gas customers and require approval by the OEB. The clearance of these financial incentives for both 2015 and 2016 results has been the subject of dispute at board hearings. The board has issued a final decision approving the utilities 2015 clearance applications (this essentially finalizes its interpretation of 2015 targets and results), but (at the time of writing), not on the 2016 clearance applications.

In the hearing for 2015 results, the utilities disputed the applicability of the net-to-gross study on several grounds, including concerns with the methodology of the study, and whether it was fair to apply the study's findings retroactively to 2015 results, or only on a go-forward basis.

The OEB considered the argument about whether it was fair to apply the evaluation study's findings to the utilities' 2015 program results, and concluded that the old free-ridership rates would be used for 2015 results. The OEB's rationale was that 2015 was a transition year, and final approval of the utilities' 2015-2020 DSM plans (this approval included new direction regarding changes to free-ridership rates, based on program evaluations) was not given until after the 2015 program year was complete.[31]

The board has issued a final decision approving the utilities 2015 clearance applications (this essentially finalizes its interpretation of 2015 targets and results), but (at the time of writing), not on the 2016 clearance applications.

The result preserved roughly $4 million dollars in incentives for Enbridge and $0.5 million for Union Gas, as shown in Table D.6.[32]

Table D.6. 2015 natural gas utility values for their shareholder incentive (draft, verified, and final OEB decision).

	2015 SHAREHOLDER INCENTIVE (million $)		
	Using old free-ridership values	**Using updated free-ridership values**	**Final Board decision**
Union Gas	$7.5	$7.04	$7.5
Enbridge	$10.08	$6.21	$10.08

Source: DNV-GL, 2015 DSM Natural Gas Annual Verification (OEB, 20 December 2017); OEB, Decision and Order, EB-2017-0324 and EB-2017-0323 (12 July 2018).

In its decision on the 2015 results, the OEB did not address the substantive arguments made by the utilities regarding the methodological concerns with the net-to-gross study, and commented that: "[t]his decision […] should not be construed as prejudging the treatment of applying the updated free ridership and spillover values to 2016 custom DSM programs."[33]

However, in filing their 2016 clearance applications, both utilities (while still noting methodological concerns) have used the updated free-ridership values for 2016 results. But the utilities have now raised another argument, based on their interpretation of previous direction from the OEB – that because the 2016 targets were set based on the old free-ridership assumptions, they are no longer based on the best available information, and should be revised (downwards) to account for the change in free-ridership values arising from the evaluation.[34] As of February 2019, the OEB had not issued a decision on this issue.[35] Pending a decision from the board, the ECO has assumed that the original 2016 targets remain in effect, and reports progress against these targets.

D.3.4 Program cost-effectiveness

The unit cost of conservation, i.e., the amount of money that utilities must spend for each verified unit of lifetime natural gas savings, increased in 2016 for the reasons described above, to 5-7¢/m^3. (Table D.7). For comparison, this is still much cheaper than the cost of natural gas. The commodity cost of natural gas (not including delivery costs) was in the range of 10-15¢/m^3 in 2015 and 2016.

The unit cost of conservation is much cheaper than the cost of natural gas.

Table D.7. Cost (non-discounted) to utility per unit of lifetime natural gas savings versus gas supply cost.

	Utility cost of conservation (non-discounted)	Gas supply cost	Utility cost of conservation (non-discounted)	Gas supply cost
	2015		2016	
Enbridge	4.3¢/m^3	15.2¢/m^3	6.6¢/m^3	10.8¢/m^3
Union	1.9¢/m^3	13.1¢/m^3	5.0¢/m^3	9.8¢/m^3

Note: Utility cost of conservation is an approximation, as natural gas savings are not tracked for a small portion of DSM spending.

Source: Enbridge, DSM final annual report (17 November 2018) at tables 3.2 and 3-9; Union Gas, 2016 DSM final annual report (30 November 2018) at tables 3.2 and 3-9; "Historical natural gas rates", Ontario Energy Board.

The cost and value of conservation programs can also be viewed from a societal perspective, using the total-resource cost plus test (TRC-plus). The benefits include cost savings from avoided natural gas consumption, any potential electricity and water savings associated with the measure, and (from 2015 onwards for Enbridge and 2016 onwards for Union) an additional 15% for non-energy benefits (like health, comfort and climate benefits). Costs include the incremental cost to customers of higher-efficiency equipment, as well as the costs of program administration, promotion, delivery and evaluation. A TRC-plus ratio higher than 1 means that a program is cost-effective for society; the higher the value the more cost-effective the program. Low-income programs are screened using a lower threshold value of 0.70 to recognize important non-energy benefits. Some programs, like market transformation, do not lend themselves to traditional TRC screening, but still provide significant benefits to society.

Gas conservation programs deliver roughly two to three dollars in benefits for every dollar spent.

The TRC ratio dipped slightly in 2016 due to the lower volume of gas savings and higher costs, but still indicates that gas conservation programs deliver roughly two to three dollars in benefits for every dollar spent.[36] Thus, utility gas conservation programs remain highly cost-effective.

Table D.8. The benefit-cost ratio of each utility natural gas programs as measured by the total resource cost plus test.

	2015	2016
Enbridge	2.95	2.6
Union	3.33	2.80

Source: DNV-GL, 2015 DSM Natural Gas Annual Verification (OEB, 20 December 2017); DNV-GL, 2016 Natural Gas Demand-Side Management Annual Verification (OEB, 30 October 2018).

D.4. Performance against targets

D.4.1 How utility performance is measured: scorecards

The OEB measures conservation performance based on each utility's scorecards. Each utility has separate scorecards for different types of programs (e.g., resource acquisition programs, whose primary targets are cumulative natural gas savings, versus market transformation programs, that attempt to cause longer-term changes to increase the role of energy efficiency in the marketplace). The scorecards include targets for each program (or group of programs), and if a scorecard has more than one target, the targets are each assigned a weight, totalling 100.

The utilities design their own scorecards based on guidance outlined in the framework.[37] The scorecards are then approved (and possibly subject to adjustments) by the OEB. The framework stipulates that programs should be varied across rate classes – to encourage broad participation – and that performance should be primarily measured based on lifetime savings and to a lesser, but still important, extent on level of participation (especially for programs designed to transform the market).

Beyond providing an overview of program achievements, the scorecards have significant financial impacts for Enbridge and Union, because their achievements determine how much (if any) of their shareholder incentive they will receive, and if utilities can access additional spending for particularly successful programs.[38]

D.4.2 2016 Scorecard results

Enbridge and Union's performance against their conservation program targets are shown at a high level for 2015 and 2016 in Figure D.3. Both utilities saw drops in performance in all scorecards in 2016. Performance on the resource acquisition scorecard (and Union's Large Volume scorecard) was affected by the change in net-to-gross assumptions discussed above in section D.3.3.

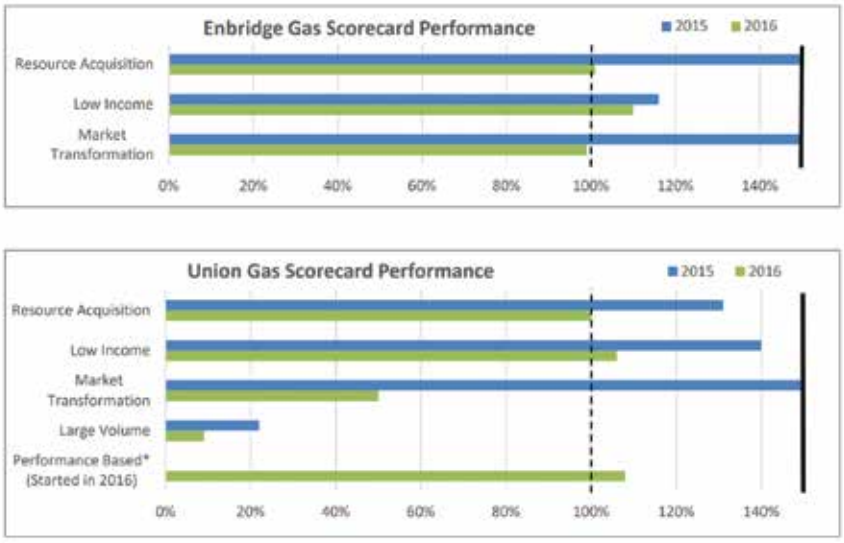


Figure D.3. Enbridge and Union performance on conservation scorecards, 2015 and 2016.

Source: OEB, Mid-Term Review of the Demand Side Management (DSM) Framework for Natural Gas Distributors (2015-2020) (29 November 2018) at 10.

Scorecard results for 2016 are shown in more detail for 2016 in Tables D.9 and D.10. The scorecard weighting and metrics help ensure utilities remain focused on different markets and programs and continue to deliver a relatively balanced and diverse portfolio to customers.

The detailed table also provides several additional important facts about programs, such as:

- the total resource plus cost/benefit ratio (a ratio >1 means the program provided more benefits to society than its costs),[39] and
- scorecard weight of each performance metric (which helps indicate how important success in the program is to the utility achieving their maximum incentive).

The detailed table also helps visualize which programs performed below targets. Red highlighting indicates performance was below 75% of the target and orange highlighting indicates performance was below 100%.

Table D.9. Summary of 2016 conservation performance metrics against OEB-established targets for Union Gas.

UNION					
Component	**Performance metric**	**TRC**	**Weight %**	**Results**	**% of Target**
RESOURCE ACQUISITION (small volume)					
Commercial and industrial (C&I) custom	Cumulative savings (million m^3 gas)	3.0	75%	544.9	67%
C&I prescriptive				159.6	
Home reno rebate				110.3	
	Participants		25%	6,595	200%
LARGE VOLUME					
Direct Access	Cumulative savings (million m^3 gas)	5.0	100%	79.9	**9%**
LOW-INCOME					
Home weatherization	Cumulative savings (million m^3 gas)	1.5	60%	45.7	**121%**
Furnace end-of-life				.03	
Multi-family (social and assisted)			35%	10.9	**67%**
Multi-family (market rate)			5%	8.2	**309%**
MARKET TRANSFORMATION					
Optimum home	% homes built	n/a	50%	70%	**100%**
Commercial new construction	Participating builders		50%	0	**0%**
PERFORMANCE BASED					
Run Smart	Participants	n/a	50%	58%	**115%**
Strategic Energy Management			50%	50%	**100%**

LEGEND: 0-75% | 76-99% | 100-150% | 151% +

Note: Targets, and performance against targets, is shown based on 2016 evaluation results. The utilities interpret the Board's previous decisions as requiring that these 2016 targets require revision, and is seeking clarification/requesting this be applied.

Source: DNV-GL, 2016 Natural Gas Demand-Side Management Annual Verification (OEB, 30 October 2018).

Table D.10. Summary of 2016 conservation performance metrics against OEB-established targets for Enbridge.

ENBRIDGE						
Component		**Performance metric**	**TRC**	**Weight**	**Results**	**% of Target**
RESOURCE ACQUISITION						
Small volume customers	Home energy conservation	Participants	2.09[40]	20%	12,986	157%
					229.7	
	Residential adaptive thermostats	Cumulative savings (million m^3 gas)		40%	45.4	124%
	Commercial and industrial (C&I) custom				15.5	
	C&I direct install				74.5	
	C&I prescriptive				29.6	
	Energy leaders initiative				0.3	
Large volume customers	C&I custom	Cumulative savings (million m^3 gas)	3.27[41]	40%	299.9	49%
	C&I direct				4.7	
	C&I prescriptive				21.8	
	Energy leaders initiative				.4	
	Run it Right				1.9	
	Comprehensive energy management				0	
LOW INCOME						
Single family		Cumulative savings (million m^3 gas)	1.9	45%	28.8	91%
Multi-residential				45%	84.7	131%
		New construction participants		10%	6	100%
MARKET TRANSFORMATION						
Residential savings by design		Homes built	n/a	15%	2,206	80%
		Enrolled builders		10%	31	94%
Commercial savings by design		New developments		25%	43	130%
School energy competition		Schools		10%	25	45%
Run-it-right		Participants		20%	84	101%
Comprehensive energy management		Participants		20%	7	100%

LEGEND: 0-75% | 76-99% | 100-150% | 151% +

Note: Targets, and performance against targets, is shown based on 2016 evaluation results. The utilities interpret the Board's previous decisions as requiring that some of these 2016 targets require revision, and is seeking clarification on this.

Source: DNV-GL, 2016 Natural Gas Demand-Side Management Annual Verification (OEB, 30 October 2018).

D.4.3 Shareholder incentives to utilities

In order to motivate the gas utilities to pursue conservation aggressively, the OEB has approved a shareholder incentive which rewards utilities for conservation performance. Each utility has a maximum incentive of $10.45 million available, if they achieve an average of 150% overall on their scorecard-weighted targets.[42] If they only achieve 100%, they receive $4.2 million in incentives.[43]

A shareholder incentive rewards utilities for conservation performance.

The incentives earned for 2015 and 2016 are very different (see Table D.11). In 2015 the utilities earned a total of $17.6 million in shareholder incentives, representing about a 26% return on their spending on conservation programs. Incentives for 2016 have not yet been approved by the OEB. If the evaluator's findings stand and 2016 targets are not adjusted (see section D.3.3), utilities will earn about $8.4 million in shareholder incentives, representing about an 8% return on their spending on conservation programs. If the OEB accepts the utilities' interpretation that 2016 targets should be adjusted, 2016 shareholder incentives could instead be roughly $10.5 million.

Table D.11. Shareholder incentive amounts earned and eligible for 2015 and 2016.

	2015				2016			
	Incentive earned (million $)	Maximum incentive (million $)	Incentive earned as % of maximum	Incentive as a % of conservation spending	Incentive earned (million $)	Maximum incentive (million $)	Incentive as % of maximum	Incentive as a % of conservation spending
Enbridge	$10.1	$11.1	93%	29%	**$4.5***	$10.45	43%	8%
Union	$7.5	$11	69%	23%	**$3.9***	$10.45	37%	9%

Note: (*) If the Board approves Enbridge and Union's 2016 Clearance applications, and agrees that 2016 targets should be revised to reflect input assumptions and net-to-gross values determined in the 2015 evaluation, then Enbridge's 2016 incentives could be $6.4 million, and Union's 2016 incentives could be $4.1 million.

Source: DNV-GL, 2015 DSM Natural Gas Demand Side Management Annual Verification (OEB, December 2017); OEB, Decision and order, Enbridge, EB-2017-0324 (12 July 2018); OEB, Decision and order, Union Gas, EB-2017-0324 (12 July 2018); Union Gas, Updated 2016 Scorecards, Demand Side Management Draft Annual Report, EB-2015-0245 (30 July 2018) at 3-4; Enbridge, Update to 2016 DSM Program Targets and Results, EB-2015-0245 (1 August 2018) at 3; DNV-GL, 2016 Natural Gas Demand-Side Management Annual Verification (OEB, 15 October 2018); Enbridge, 2016 deferral filing, EB-2018-0301 (30 November 2018) at exhibit A, tab 1, sch.2, p.2; Union Gas, 2016 deferral filing, EB-2018-0300 (10 December 2018) at exhibit A, tab 1, p.3.

D.5 Program highlights by customer sector

Figure D.4 shows the share of natural gas savings from programs for each major customer segment in 2016 (for both utilities combined). Even with the reduced savings for the commercial/industrial sector due to the updated 2015 net-to-gross evaluation inputs, this sector still delivers the majority of program savings. Some highlights of program delivery in 2016 for each customer segment follow, including market transformation programs, which use performance metrics other than natural gas savings.

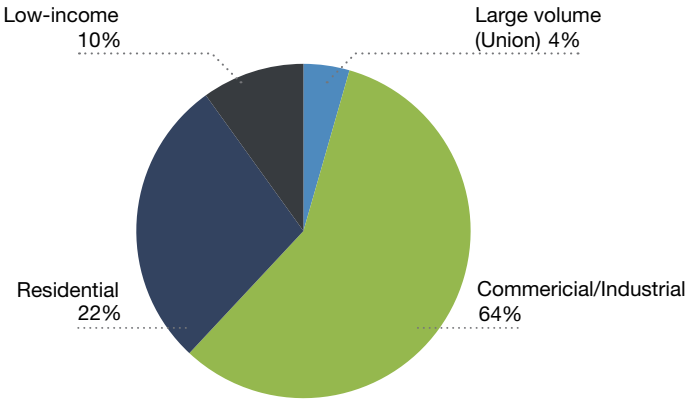


Figure D.4. Share of 2016 conservation programs savings by program sector (net cumulative).

Source: DNV-GL, 2016 Natural Gas Demand-Side Management Annual Verification (OEB, 30 October 2018) at tables 1 and 6.

The commercial/industrial sector delivers the majority of program savings.

D.5.1 Residential

As noted earlier, both utilities saw large increases in spending on residential conservation programs between 2015 and 2016. The 2015-2020 Framework expected about 40% of conservation program spending to be dedicated to the residential class.[44] The OEB nonetheless approved Union's plan to spend 15% of their 2016 budget on this customer group. Enbridge did achieve the expected 40% share of overall budget on this segment in 2016, while Union fell short of 40%, but still overachieved its OEB-approved budget at 25%.[45] This increase in spending for the residential sector was needed – in 2015, Enbridge had to suspend its residential program mid-year due to lack of budget.[46] Beginning in 2016 and continuing in 2017 and part of 2018, funding from the Green Investment Fund helped Enbridge and Union deliver residential programs to even more customers. Results attributed to the Green Investment Fund are not shown here and do not count towards utility targets.

The increase in savings from the residential sector has been quite dramatic.

The primary residential programs are Enbridge's Home Energy Conservation and Union's Home Reno Rebate programs.[47] These involve an initial energy audit to identify potential energy saving measures, then installation of two or more identified measures, with a follow-up visit to verify installation. As discussed in **Chapter 2** of this report, growth in these programs is a positive start in improving the efficiency of Ontario's existing homes, but to date, only a small share of participating customers have used these programs to implement building envelope improvements that can deliver deeper energy savings.

The increase in savings from the residential sector has been quite dramatic, as shown in Figure D.5. The rate of participation has also grown (from 8,175 houses in 2015 to 19,581 in 2016), but is still quite low when assessed as a share of overall Ontario households.

Table D.12. Number of residential customers participating in whole home energy conservation programs (2015-2016).

	2015	2016
Enbridge	5,646	12,986
Union	2,529	6,595

Source: OEB, Mid-Term Review of the Demand Side Management (DSM) Framework for Natural Gas Distributors (2015-2020) (29 November 2018) at 11.

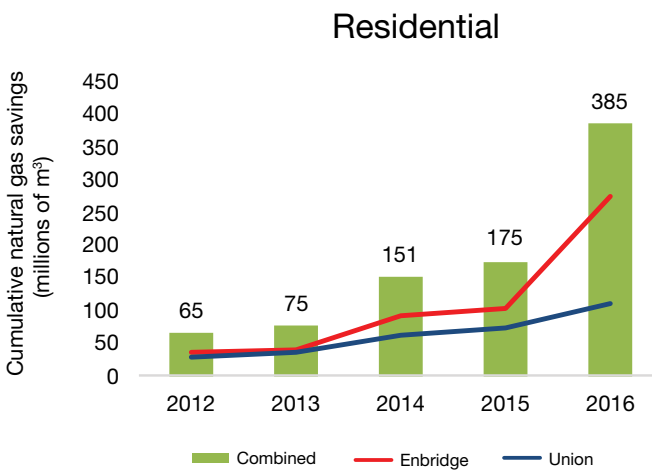


Figure D.5. Net cumulative residential program savings for Enbridge, Union Gas and both combined, 2012-2016.

Source: DNV-GL, 2015 Natural Gas Demand Side Management Annual Verification (OEB, 20 December 2017) at tables 1-1 and 1-6; DNV-GL, 2016 Natural Gas Demand Side Management Annual Verification (OEB, 30 October 2018) at tables 1 and 6; 2012 to 2014 results from: ECO, Every Joule Counts (2017) at figures 5.1 and 5.2.

D.5.2 Commercial/Industrial

Both utilities saw significantly reduced savings from their commercial/industrial customers, which are due to the net-to-gross adjustment discussed in section D.3.3.

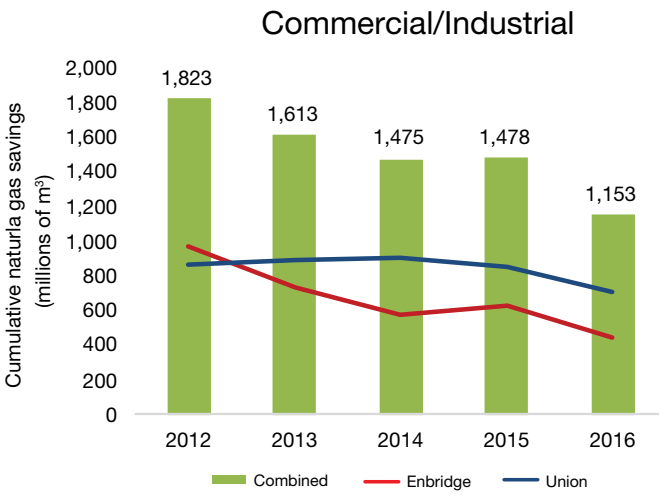


Figure D.6. Net cumulative commercial/industrial programs savings for Enbridge, Union Gas and both combined 2012-2016.

Source: DNV-GL, 2015 Natural Gas Demand Side Management Annual Verification (OEB, 20 December 2017) at tables 1-1 and 1-6; DNV-GL, 2016 Natural Gas Demand Side Management Annual Verification (OEB, 30 October 2018) at tables 1 and 6; 2012 to 2014 results from: ECO, Every Joule Counts (2017) at figures 5.1 and 5.2.

According to the utilities, the commercial/industrial sector programs are becoming costlier to operate and are delivering less savings per participant.[48] Utilities are trying to serve small business customers better, based on framework guidance. These customers generally have fewer resources (both financial and personnel) to dedicate to energy conservation projects. This means there is a need for higher incentive levels and higher program costs.[49]

Utilities are trying to serve small business customers better.

For the first time, in 2016 Enbridge separated its scorecard into smaller and larger volume customers, to give more emphasis on reaching smaller customers.[50] It also launched a new direct install program serving the smaller business market: an air curtain door program suitable for warehouses and industrial facilities, which covers most of the costs and offers a prequalified product and selected contractor, making

it easier for smaller businesses to participate.[51] This program delivered 79.2 million m^3 of savings in 2016. Union has now launched a similar program but was not in market in 2016.[52]

D.5.3 Large Volume (Union)

Union's service territory has a unique program for very large industrial customers. The conservation programs provided to this small customer class are unique as each customer has first right of access to its share of conservation funds, which it can use for conservation projects of its choice (subject to a few limitations), with technical assistance from Union's conservation staff. In 2016, 97% of customers in this class submitted energy efficiency plans, with 61% of customers accessing funding for at least one conservation project.[53] If the customer does not make full use of its share of conservation funds, the funds are made available to other customers in this segment.

In 2016, 75% of program savings came from projects undertaken by participants using their assigned share of conservation funds, with the other 25% of savings coming from projects undertaken by a customer using funds provided by other customers (and not used by the original customers).[54]

Despite the relatively high share these savings represented of overall savings in 2016, this share was substantially lower than in 2015 (see figure D.7). This drop was due to the adjustments to the free-ridership rate described in section D.3.3. This program has the lowest net-to-gross ratio (8% – i.e., the highest free-ridership rate, at 92%), as its customers are large industrial customers who may already have energy management professionals on staff, and be suitably motivated and able to complete projects without utility assistance. However, even with such a low net-to-gross ratio, the funds spent on this program still delivered a large net benefit in 2016.

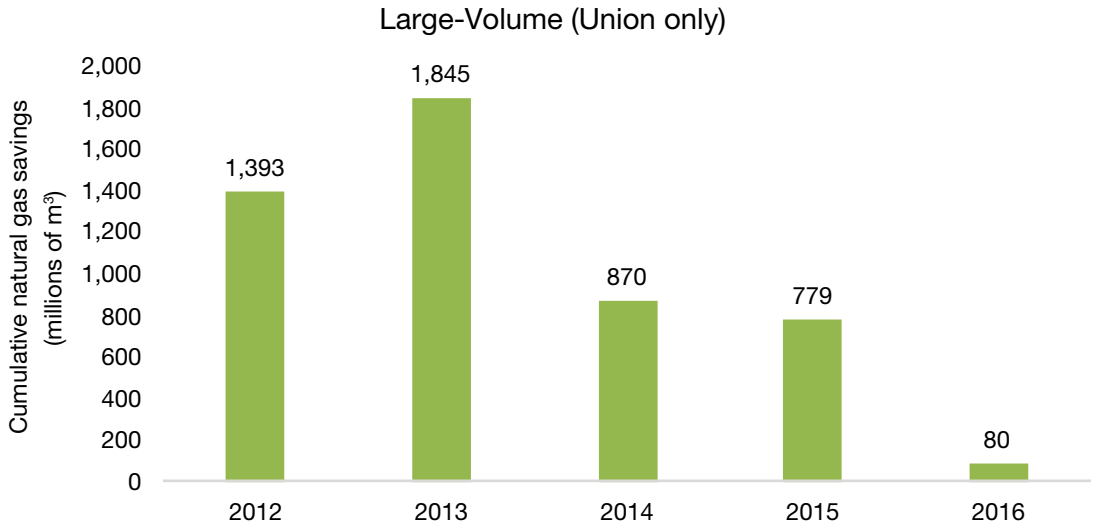


Figure D.7. Net cumulative large volume program savings, 2012-2016 (Union Gas).

Source: DNV-GL, 2015 Natural Gas Demand Side Management Annual Verification (OEB, 20 December 2017) at tables 1-1 and 1-6; DNV-GL, 2016 Natural Gas Demand Side Management Annual Verification (OEB, 30 October 2018) at tables 1 and 6; 2012 to 2014 results from: ECO, Every Joule Counts (2017) at figures 5.1 and 5.2.

D.5.4 Low-Income

Low-income programs expanded in 2016 because of guidance in the new framework,[55] though overall, they still represent a small share of each utility's conservation portfolio, both in terms of natural gas savings and spending (see figure D.4).[56] Low-income programs tend to be more expensive to run, because they often include higher incentives, and may cover the entire cost of conservation measures for customers (e.g., the Home Weatherization Program discussed in **Chapter 2** of this report).

Enbridge saw a large increase in savings from multi-unit residential projects in 2016. It also launched a new Low-Income New Construction program to assist new housing built through the Federal-Provincial Investment in Affordable Housing Program in reaching energy efficiency levels higher than the Building Code requirements.[57] Union introduced a furnace end-of-life upgrade offering in the social and assisted housing market and secured necessary agreements for the new Low-Income Single Family Indigenous Offering that launched in 2017. Also in 2016, Union expanded its multi-residential program for low-income customers beyond social housing, to private sector buildings with a significant share of low-income tenants, and saw much higher savings than projected for this sector.[58] Enbridge had already done this in previous years.

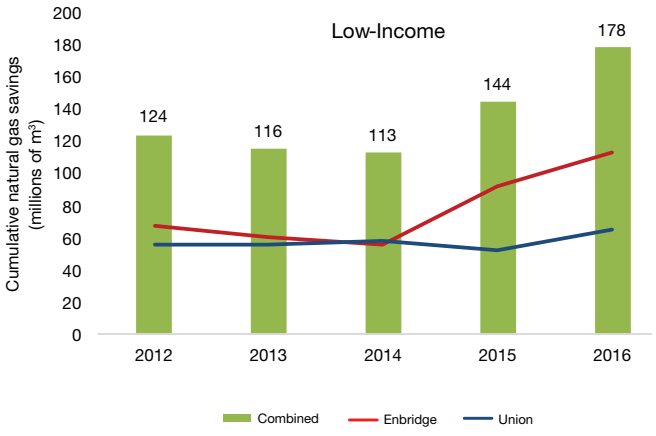


Figure D.8. Cumulative low-income program savings, for Union Gas, Enbridge and both combined, 2012-2016.

Source: DNV-GL, 2015 Natural Gas Demand Side Management Annual Verification (OEB, 20 December 2017) at tables 1-1 and 1-6; DNV-GL, 2016 Natural Gas Demand Side Management Annual Verification (OEB, 30 October 2018) at tables 1 and 6; 2012 to 2014 results from: ECO, Every Joule Counts (2017) at figures 5.1 and 5.2.

D.5.5 Market transformation and performance-based programs

Market transformation programs are intended to create a lasting change in market behaviour and customer attitudes, by making energy efficiency standard practice.

Enbridge offered five market transformation programs in 2016, to support energy efficient design in new residential and commercial construction, and to build a culture of energy efficiency in commercial buildings, industrial facilities and schools. Two of these programs were new in 2016.[59]

Union offers a market transformation program for new residential construction and had intended to launch a new program to encourage high-efficiency design in commercial and industrial new construction, but was unable to launch the program in time to enroll any participating builders in 2016.[60] This lack of results accounts for Union's poor performance on their Market Transformation scorecard.

Union has a separate performance-based program scorecard, which includes its RunSmart and Strategic Energy Management offerings. Together, these programs achieved 108% of their target in 2016. Performance-based conservation benchmarks use a customer's energy use to evaluate energy saving opportunities and then measures ongoing savings using an evidence-based approach (e.g., comparing before and after metered billing data).

Enbridge also offers similar programs, namely Run-it-Right and Comprehensive Energy Management, which are measured on their Resource Acquisition and Market Transformation scorecards, depending on the metric.

Endnotes

1. In addition to Enbridge and Union, Ontario has three, much smaller, natural gas distributors (i.e., EPCOR, Kitchener Utilities and Utilities Kingston), but these do not have any OEB-approved conservation programs.
2. Ontario Energy Board, Demand Side Management Framework for Natural Gas Distributors (2015-2020) EB-2014-1034 (Toronto: OEB, 22 December 2014).
3. Ibid, at 63 (re: targets), at 77 (re: plans); See also, Environmental Commissioner of Ontario, Every joule Counts (Toronto: ECO, 2017) at 58, 62-63.
4. This approach was accepted by the OEB in its decision on both Union and Enbridge's 2015 Clearance of Deferral and Variance Accounts, EB-2017-0323/EB-2017-0324 (Toronto: OEB, 12 July 2018).
5. The issue of whether or not 2016 targets should be adjusted with the updated net-to-gross values is currently before the Board.
6. Ontario Energy Board, Demand Side Management Framework for Natural Gas Distributors (2015-2020) EB-2014-1034 (Toronto: OEB, 22 December 2014) at 64-65.
7. Inconveniently, Ontario's electricity utilities currently calculate their conservation savings with different terminology and in a slightly different manner. As Appendix C explains, electricity utilities work towards a 'persistent savings' target, a metric which calculates savings based on what savings will remain at the end of their framework (2020). Electricity savings are also measured on an 'incremental basis' (i.e., savings in the first year of a program), which is comparable to the annual natural gas savings noted here.
8. According to the most recent study, 25 years is consistent with North American best practices. (DNV-GL, 2016 Verified DSM Results (Toronto: OEB, 30 October 2018) at 9 and 59.
9. Low-flow showerheads are assumed to have a 10-year life. (Ontario Energy Board, Natural Gas Demand Side Management Technical Resource Manual, Version 3.0 (OEB: Toronto, 30 November 2018) at 7.)
10. If the updated net-to-gross assumptions had been used for 2015 results, 2015 overall net savings would have been 1.68 billion m^3 (0.54 billion m^3 for Enbridge and 1.14 billion m^3 for Union Gas, 7% lower than the 2016 overall savings of 1.80 billion m^3). (DNV-GL, 2015 Natural Gas Demand Side Management Annual Verification (Toronto: OEB, 20 December, 2017) at 2 and 4.)
11. For context, the American Council for an Energy Efficient Economy estimates that in the U.S. the economic potential for annual gas savings represents about 2% of annual sales, and the achievable potential (i.e., taking into account the fact that not all economic energy efficient opportunities will be adopted) is about 1% annually, without including a cost of carbon. (American Council for an Energy Efficient Economy, Natural Gas Energy Efficiency: Progress and Opportunities (Washington D.C.: ACEEE, July 2017) at 17.)
12. This estimate assumes persistence in 2016 of all savings from 2007 onwards. Annual savings in the years prior to 2007 are not available. If they were included, the impact in 2016 could be higher, because savings from natural gas conservation programs persist on average for 16 years, and conservation programs have been in place since before 2000. (Ibid, at 10).
13. 1.7 billion m^3 of persistent natural gas savings divided by the average natural gas consumption by a home (2400 m^3).
14. Compares 2016 natural gas sales volumes to 2007 (see each utilities' 2016 annual reports, section 3, table 3.10). Warmer weather in 2016 likely reduced overall utility sales.

	HDD (Toronto Pearson)	HDD (Timmins)
2014	4,103	6,502
2015	3,766	5,975
2016	3,462	5,693

Source: "Historical weather data", online: Government of Canada < climate.weather.gc.ca/climate_data/generate_chart_e.html?StationID=29906&timeframe=2&type=bar&MeasTypeID=heatingdegreedays>. [Accessed 6 March 2019]

15. 1,700 million m^3 reduction in annual natural gas use due to conservation activity, multiplied by an emissions factor of 1,898 tonnes CO_2e/million m^3, based on emission factors in Environment and Climate Change Canada, National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada, Part 2 (2018) at 210-211 (Ontario CO2 emission factor for natural gas, and industrial CH_4 and N_2O emission factors for natural gas).
16. 18% of an overall 18 Mt emissions reduction. (Ministry of the Environment, Conservation and Parks, Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan, Draft (Queen's Printer for Ontario, 2018) at 24.)
17. Ministry of the Environment and Climate Change, Guideline for Greenhouse Gas Emissions Reporting (Toronto: MOECC, December 2015) at 86 (Appendix 10, Tables 20.3 (for CO_2) and 20.4 (for CH_4 and N_2O)).
18. Calculation: volume of net natural gas savings multiplied by the combined global warming potential of the three GHGs associated with natural gas combustion:

Greenhouse Gas	Emission factor (g/m^3) x global warming potential =
CO_2	1,888 x 1 = 1,888
CH_4	0.037 x 25 = 0.93
N_2O	0.035 * 298 = 10.43
Total	1,899 g CO_2e/m^3 natural gas combustion

For example, using Enbridge's 2016 annual natural gas savings = 50.5 million m^3 x 1,898 tonnes CO_2e/million m^3 = 95,917.43 tonnes CO_2e. (Calculation based on net annual natural gas savings from: Enbridge, 2016 DSM Annual Report (17 November 2018) at table 3.10; Union Gas, 2016 DSM Final Annual Report (30 November 2018) at table 3.10.; and Environment and Climate Change Canada, National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada, Part 1 (2018) at 11, and Part 2 (2018) at 210-211 (Ontario CO^2 emission factor for natural gas, and industrial CH_4 and N_2O emission factors for natural gas).

19. Ontario Energy Board, Demand Side Management Framework for Natural Gas Distributors (2015-2020) EB-2014-0134 (22 December 2014) at 17.
20. Ibid, at 8.
21. Ibid, at 17.

22. As compared to 2015, the 2016 DSM plans included an increased focus on mass market/residential programs (i.e. significantly expanded Home Energy Conservation spending and the addition of a new Adaptive Thermostats initiative), which required higher relative spending and incentives per project than commercial/industrial projects, and which drive lower per project m^3 savings. Ontario Energy Board, Decision and Order on 2015-2020 DSM plans, EB-2015-0029/EB-2015-0049 (20 January 2016) at 67-68.

23. Ontario Energy Board, Decision and Order on 2015-2020 DSM plans, EB-2015-0029/EB-2015-0049 (20 January 2016) at 69.

24. Ontario Energy Board, 2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation by DNV-GL (Toronto: OEB, 12 October 2017).

25. Spillover, which tracks additional conservation actions that a customer takes outside of a conservation program, but influenced (in part or whole) by the program, is the other component. It leads to an increase in net savings, but its impact is usually much less than the free-ridership adjustment.

26. This is the "gross realization rate." (DNV-GL, 2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation (Toronto: OEB, 12 October 2017) at 9.)

27. DNV-GL, 2015 Natural Gas Demand Side Management Annual Verification (Toronto: OEB, 20 December 2017) at Tables N-1 and N-2.

28. Union also has a self-direct option for their Large Volume customers, where participation allows access to a conservation fund the customer pays into.

29. Enbridge, Application and Supporting Evidence, EB-2018-0301 (Toronto: OEB, 10 December 2018) at Exhibit B Tab 1 Schedule 1, pages 14-17.

30. TRC-plus ratios of 5.8 for Enbridge's custom industrial programs, and 2.9 for Enbridge's custom commercial programs (Enbridge, DSM final annual report (North York, ON: Enbridge, 17 November 2018) at Table 4.3); Union's custom commercial/industrial programs and large-volume programs had TRC-plus ratios of 3.73 and 5.2, respectively (Union Gas, 2016 DSM final annual report (Chatham, ON: Union Gas, 30 November 2018) at Tables 5.10 and 7.3).

31. The specific language used in OEB's decision on the 2015-2020 plans: "the OEB does not expect the gas utilities to rely on a predetermined free ridership rate for the duration of the 2017 to 2020 term. In 2016, the free rider rates will be updated based on the results of the net-to-gross study and the annual evaluation process. Annually, the evaluation process will continue to inform the free rider rates for custom programs." (Ontario Energy Board, Union Gas and Enbridge decision and order, EB-2015-0029/EB-2015-0049 (Toronto: OEB, 20 January 2016) at 21)

32. The financial impact on Enbridge's utility incentives was much larger, due to differences in how the utility performance scorecards were structured, and utility-specific differences between the old and new free-ridership rates.

33. Ontario Energy Board, Decision and Order, EB-2017-0324 (Toronto: OEB, 12 July 2018) at 7.

34. Enbridge, Application and Supporting Evidence, EB-2018-0301 (Toronto: OEB, 10 December 2018) at exhibit B tab 1 Sch.1, p.3.

35. The clearance of 2016 results is being reviewed in cases EB-2018-0301 (Enbridge) and EB-2018-0300 (Union Gas).

36. The benefit-cost ratios of natural gas programs using the TRC-plus test are not proportionally affected as much by the change in net-to-gross ratios as the utility unit cost of savings is. This is because the change removes a significant component of both the numerator (energy savings) and the denominator (incremental customer costs) in the TRC-plus test.

37. Ontario Energy Board, Demand Side Management Framework for Natural Gas Distributors (2015-2020), EB-2014-0134 (Toronto: OEB, 22 December 2014) at 11-13.

38. "The option to spend 15% above the approved annual DSM budget is meant to allow the natural gas utilities to aggressively pursue programs which prove to be very successful." (OEB, Filing Guidelines to the 2015-2020 DSM Framework for Natural Gas Dristributors, EB-2014-0134 (Toronto: OEB, 22 December 2014) at 38.

39. "The TRC test includes the costs and benefits experienced by the utility system, plus costs and benefits to program participants, and is often considered to measure the net benefits to the region as a whole." (DNV-GL, 2016 Natural Gas Demand Side Management Annual Verification (Toronto: OEB, 30 October 2018) at 3).

40. DNV-GL, 2016 Natural Gas Demand Side Management Annual Verification (Toronto: OEB, 30 October 2018) at Table 256.

41. Ibid, at Table 257.

42. Ontario Energy Board, Demand Side Management Framework for Natural Gas Distributors (2015-2020) EB-2014-0134 (22 December 2014) at 22.

43. Ibid, at 23.

    "More specifically, 40% of the maximum shareholder incentive available (or $4.2 million) should be provided for performance achieving a scorecard weighted score of 100%, with the remaining 60% (or $6.3 million) available for performance at 150% and for achievement of targets for priority programs."

44. Ibid, at 18.

45. DNV-GL, 2016 Natural Gas Demand Side Management Annual Verification (Toronto: OEB, 30 October 2018).

46. Enbridge, DSM final annual report (North York, ON: Enbridge, 17 November 2018) at 32.

47. Ontario Energy Board, Demand Side Management Framework for Natural Gas Distributors (2015-2020) EB-2014-0134 (22 December 2014) at 26.

48. Enbridge, "DSM mid-term review" (presentation, 6 September 2018) at slide 9.

49. Union Gas, "DSM mid-term review presentation" (presentation, 6 September 2018) at slide 10.

50. The small volume metric includes savings from DSM participants with a three-year average annual consumption of less than 75,000 m^3/year in the Commercial sector or 340,000 m^3/year in the Industrial sector, and also includes savings from the Residential sector. (Enbridge, DSM final annual report (North York, ON: Enbridge, 17 November 2018) at 26.)

51. Ibid, at 64-67.

52. Union Gas, 2016 DSM final annual report (Chatham, ON: Union Gas, 30 November 2018) at 58-59.

53. Ibid, at 95.

54. Ibid.

55. Ontario Energy Board, Demand Side Management Framework for Natural Gas Distributors (2015-2020) EB-2014-0134 (Toronto: OEB, 22 December 2014) at 26.

56. DNV-GL, 2016 Natural Gas Demand Side Management Annual Verification (Toronto: OEB, 30 October 2018).

57. Enbridge, DSM annual report (North York, ON: Enbridge, 17 November 2018) at 74-75, 89-92.

58. Union Gas, 2016 DSM final annual report (Chatham, ON: Union Gas, 30 November 2018) at 70-71.

59. Enbridge, DSM annual report (North York, ON: Enbridge, 17 November 2018) at 96.

60. Union Gas, 2016 DSM final annual report (Chatham, ON: Union Gas, 30 November 2018) at 103.

Thanks and acknowledgments

The Environmental Commissioner of Ontario would not have been able to produce this report without the invaluable assistance, input and feedback of many individuals and organizations, including those listed below, and some that have asked to remain anonymous. However, this report represents the views of the ECO and does not imply endorsement from any other individual or organization.

Ontario Government Ministries, Agencies, and Legislative Offices
Independent Electricity System Operator, Ministry of Energy, Northern Development and Mines, Ministry of the Environment, Conservation and Parks, Ministry of Infrastructure, Ministry of Municipal Affairs and Housing, Ministry of Transportation, Ontario Energy Board

Organizations
Alectra Utilities, American Electric Power Ohio, Burman Energy, City of Guelph, City of Vancouver, CustomerFirst, Efficiency Canada, Efficiency Vermont, Electricity Distributors Association, Enbridge Gas Distribution, EnerQuality, Enviro-Stewards, Evergreen, Great Northern Insulation, Greening Homes, Hydro Ottawa, London Hydro, Manitoba Hydro, Natural Resources Canada, Neptis Foundation, Niagara Peninsula Energy Inc., Now House, Ryerson City Building Institute, Samuel & Son, Statistics Canada, Summerhill, Tahoe Canada/ Lake Shore Gold, Toronto Transit Commission, Tridel Group of Companies, Union Gas, University of Toronto Data Management Group

Individuals
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Acronyms

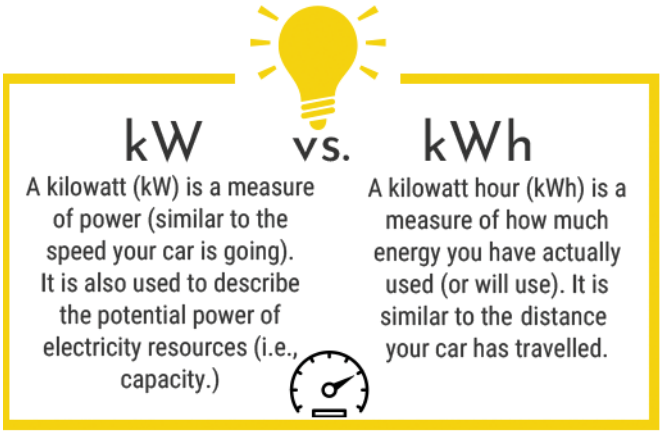
ACEEE	American Council for an Energy-Efficient Economy
APS	Achievable Potential Study
AV	autonomous vehicle
BMG	behind-the-meter generation
CBDR	Capacity Based Demand Response
CCM	cumulative cubic metre
CDM	conservation and demand management
CFF	Conservation First Framework
CHP	combined heat and power
CO_2e	carbon dioxide equivalent
DR	demand response
DSM	demand-side management
ECO	Environmental Commissioner of Ontario
EM&V	Evaluation, Measurement and Verification
EPP	Energy Performance Program
EV	electric vehicle
GA	Global Adjustment
GDP	Gross Domestic Product
GEA	Green Energy Act
GHG	greenhouse gas
GGH	Greater Golden Horseshoe
GTHA	Greater Toronto and Hamilton Area
HAP	Home Assistance Program
HPNC	High Performance New Construction
IESO	Independent Electricity System Operator
IAP	Industrial Accelerator Program
IRP	integrated resource planning
LDC	local distribution company
LED	light-emitting diode
LEED	Leadership in Energy and Environmental Design
LIC	Local Improvement Charge
LTEP	Long-Term Energy Plan
LUEC	levelized unit energy cost
MENDM	Ministry of Energy, Northern Development and Mines
MECP	Ministry of Environment, Conservation and Parks
MMAH	Ministry of Municipal Affairs and Housing
MOF	Ministry of Finance
MTO	Ministry of Transportation
Mt	megatonne (one million metric tonnes)
m^3	cubic metre
OBF	on-bill financing
OEB	Ontario Energy Board
OPA	Ontario Power Authority
OPG	Ontario Power Generation
PAC	program administrator cost
PKM	passenger-kilometre
PSU	Process and Systems Upgrade
SBG	surplus baseload generation
TRC	total resource cost
UGC	Urban Growth Centre
VOC	volatile organic compound
VKT	vehicle-kilometres travelled

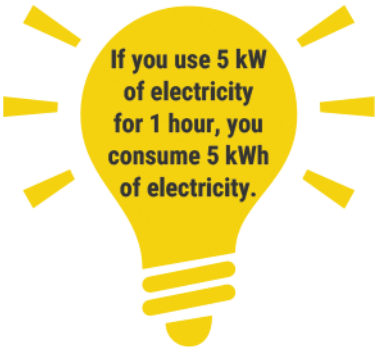
Power

kW	kilowatt	(1,000 watts)
MW	megawatt	(1,000,000 watts)
GW	gigawatt	(1,000,000,000 watts)
TW	terawatt	(1,000,000,000,000 watts)

Energy

kWh	(1,000 watt-hours)
MWh	(1,000,000 watt-hours)
GWh	(1,000,000,000 watt-hours)
TWh	(1,000,000,000,000 watt-hours)





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