Climate Action in Ontario:
What's Next?

2018 Greenhouse Gas Progress Report

Environmental Commissioner of Ontario

How can Ontario rebuild its climate policy?

Here's how to start.

The ECO recommends that the provincial government develop a climate framework with the following central features:

1. Commit: targets and law

a. A climate law that commits the provincial government to a credible, long-term program to achieve statutory emission reductions that:
   i. meets Ontario's fair share of Canada's emission reduction obligations and creates good jobs (see sections 1.5 and 3.1 of this report), and
   ii. meets the requirements of the Pan-Canadian Framework to unlock federal funds (section 3.3).

b. Legally binding carbon budgets set well in advance, based on non-partisan, expert advice, coupled with rigorous progress reporting and independent evaluation (section 2.1).

c. Provincial leadership on adaptation and preservation of natural areas (Part 4).

2. Plan a pathway

a. A transparent, achievable, cost-effective pathway to each carbon budget. The model described in this report is a good start. Note: The lowest cost pathways require much more clean electricity and storage than the current Long-Term Energy Plan will provide (section 3.1).

3. Take action

a. Effective policy tools to achieve the necessary emission reductions, using the lowest cost pathway, public health and ecological integrity to choose priorities. Appendix A contains a convenient menu of the potential tools discussed in this report.

b. Act fast and take advantage of work already done, here and elsewhere. Ontario is not starting from scratch and does not need to reinvent the wheel. Build on the best of the previous programs. Emphasize efficiency first (e.g., in social housing, schools, hospitals) (section 1.3, Appendix B).

c. Minimize disruption from the cancellation of previous programs (section 1.4).

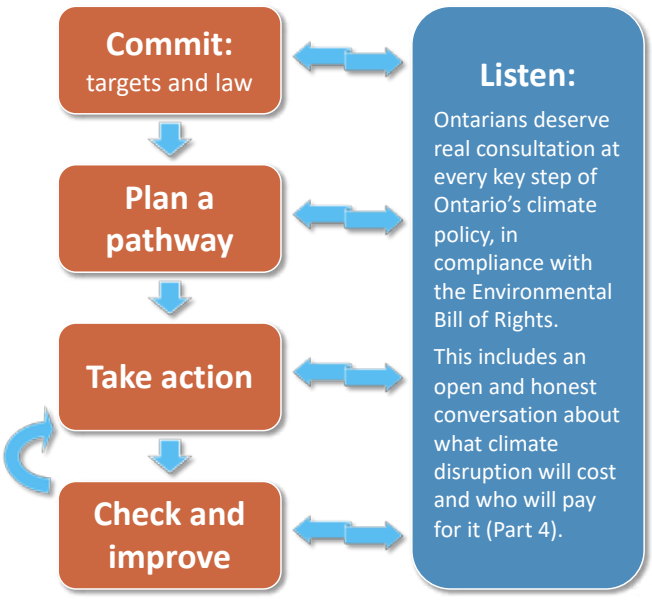
4. Check and improve

a. Monitor and report progress to the public, with third-party validation (section 2.2), and

b. Revise plan and actions as needed to stay on track for targets (section 2.2).

Listen

At each stage, it is essential to listen to Ontarians. Ontarians deserve a real consultation, in compliance with the *Environmental Bill of Rights*, on every key step of Ontario climate policy. This includes having an open and honest conversation about what climate disruption will cost and who will pay for it (Part 4). Climate policy is too important to be decided behind closed doors, without telling Ontarians what is planned or hearing what they have to say (section 2.2).



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

September 2018

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 58.2 of the *Environmental Bill of Rights, 1993* (*EBR*), I am pleased to present the 2018 Greenhouse Gas Progress Report of the Environmental Commissioner of Ontario for your submission to the Legislative Assembly of Ontario. This Annual Report is my independent review of the progress of activities in Ontario to reduce emissions of greenhouse gases.

Sincerely,

D Saxe

Dianne Saxe
Environmental Commissioner of Ontario

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Introduction

The challenges of the transition to a low carbon economy are great, but the opportunities are greater.

Accelerating Green Finance, UK Green Finance Task Force

Ontario has a huge climate challenge.

Ontario has a huge climate challenge. It is no longer possible for us to have both a safe, predictable climate that sustains our lives and economy, and unlimited fossil fuel use. We must take most fossil fuels and other sources of greenhouse gases (GHGs) out of our economy – soon – or the consequences may overwhelm us. No one wants to contaminate the world our children will live in, but that's what fossil fuels do. Ontario must also get ready for the impacts of climate disruption, both those that have arrived and those that are still ahead.

Ontarians can pull together to meet this challenge. There are opportunities all over our province to reduce fossil fuel use, to protect natural systems and to build better lives for us and for future generations. There can be challenging adjustments along the way, and we must all be willing to make some changes and some sacrifices. But the changes we need seem harder and scarier than they really are, and they bring along with them important health and economic benefits.

To succeed requires both urgency and patience. Urgency, because only urgent action can stem the tide of impacts we are now feeling from climate disruption, preserve our way of life and turn this challenge into opportunity. Each additional tonne of GHGs makes the problem bigger. And patience, because it takes time for policy and investment changes to have much effect on reducing the emissions that drive climate change. Industries and investors need government policies to deliver a steady, reliable signal as to what can be expected, looking ten years ahead and longer.

Ontario is already on its way. Low-carbon ideas, innovation and opportunities have bloomed as Ontarians use their intelligence, resourcefulness, and passion for the future of their children to transform their use of energy and to look after their communities. Businesses, municipalities, citizen groups, colleges, universities and many others have shown how, and they are ready to do more.

Ontario is already on its way.

But they cannot do their best without leadership from the provincial government. An effective response to climate change does not have to mean government spending more money, but the government has essential roles that no one else can play. Only with strong, clear provincial rules, targets and incentives can individuals, municipalities and the private sector build on the momentum and do their best.

The government has essential roles that no one else can play.

There is no mystery in the key roles that the provincial government must play. It is the government's responsibility to:

- **Set strong, legally binding, durable targets and metrics.** Emission reduction targets should be consistent with Canada's international obligations and climate science; and set by statute, with firm short- and long-term dates.
- **Build public understanding.** Ontarians need an open conversation about climate risks and opportunities, what they will cost and who will pay for them. The government should engage and empower Ontarians by giving them information and tools they need. People need to know that everyone is doing their fair share, what solutions work and where to get them, and how their own role fits in. They also need to know that what seems appealing in the shortrun, such as reducing the cost of gasoline, damages our chances of being winners in the new low-carbon economy.
- **Listen to Ontarians.** It is the law. *The Environmental Bill of Rights* gives Ontarians the right to participate in significant environmental decisions of the provincial government, and climate policy involves some of the most significant environmental decisions that the provincial government can make. Ontarians have a lot to contribute when it comes to good climate policy. The government does not know everything.
- **Set rules and incentives that drive down, and provide alternatives to, fossil fuel use.** We all need both the ability and the economic incentive to dramatically reduce our use of fossil fuels. This will only happen when fossil fuels are less necessary, less available, less convenient, less permitted, less socially acceptable and/or more expensive. Fossil fuel use will not go down enough by itself.
- **Avoid locking in fossil fuel dependence, which drives emissions up.** It is cheaper and more effective to design efficiency and low emissions into new communities, buildings, vehicles and infrastructure than to try and retrofit them later.
- **Support cleaner technologies.** New technical solutions can drive down the cost and pave the way to a greener economy. Government should fund the research and innovations that Ontario needs, and support them with adequate funding and incentives.
- **Measure and report progress.** Regular public reports on where we started, how far we have come, where we are on track and where we are falling behind allow government, and the people of Ontario, to learn from experience and to improve how policy tools work. Independent, non-partisan evaluations of the reports can help keep them credible.
- **Lead by example.** Government can show Ontarians how it is done, and prove that we can do it.

The ECO will report to the Speaker, and to the people of Ontario, on how well the provincial government accomplishes each of these roles.

Summary

Dianne Saxe
Environmental Commissioner of Ontario

Part 1: Ontario (again) needs a climate policy

Ontario has a huge climate challenge.

Although climate disruption is already starting to hammer Ontario, we continue to emit high levels of greenhouse gas pollution. It is no longer possible for us to have what we all want: both a safe, predictable climate that sustains our lives and economy and unlimited fossil fuel use. Like other places, Ontario must take most fossil fuels and other sources of greenhouse gases out of our economy, and soon.

Despite the odds, Ontario can still meet this challenge. There are opportunities all over Ontario to be less wasteful and more self-reliant, while building better lives. Businesses, municipalities, citizen groups, universities and others have shown the way, and are ready to do more.

The government has essential roles that no one else can play.

But they cannot do it without strong leadership from the provincial government. An effective response to climate change does not have to mean government spending more. But the government has essential roles that no one else can play. Only with strong, clear provincial targets, rules and incentives can individuals, municipalities and the private sector do their best. Fortunately, a good climate policy is still achievable, and would bring Ontario many benefits.

Climate disruption already affects Ontario, and will get worse.

1.1 Why climate disruption matters in Ontario

The science of climate change is beyond reasonable doubt. After 30 years of intense study, virtually all of the world's climate scientists agree: climate disruption is here, and accelerating faster than seemed possible just a few years ago. It affects us, not just polar bears. We humans cause it, and every time we use fossil fuels (e.g., gasoline, natural gas), we make it worse. No one wants to contaminate the world we and our children live in, but that's what using fossil fuels does.

What used to be "normal" weather is gone.

Photo credit: Shawn Goldberg / Alamy Stock Photo

What used to be "normal" weather is gone, and cannot come back. Extreme events, e.g., heat waves, drought and storms, are affecting people across the province. Warmer, wilder, unpredictable weather is damaging tourism, agriculture and infrastructure. Flooding has devastated some Ontario families. Hotter weather and wildfire smoke pollute air and damage public health. Lyme disease, the first climate disruption epidemic, has reached Ontario. Water supplies and wildlife in some areas are stressed. Fire-fighting costs and insurance losses are rising. Ten percent of Canadian properties may soon be too high risk to be insured by the private sector if no measures are taken to mitigate flood risk by the owner or through public policy.

Worst case climate scenarios are all too believable and should be central concerns of contemporary public policy.

If we work together, it is not yet too late.

If we work together, it is not yet too late to reduce the damage that is coming. In 2015, all the countries of the world agreed to work together to protect ourselves and our children from the overwhelming threats of climate change. Canada made important international commitments to do its fair share in this global task; Ontario can, and must, do its part.

1.2 Ontario's greenhouse gas emissions were dropping

Ontario's greenhouse gas emissions in 2016 were the lowest since reporting began in 1990. This continues the recent downward trend in emissions that allowed Ontario to meet its 2014 emissions-reduction target of 6% below 1990 levels.

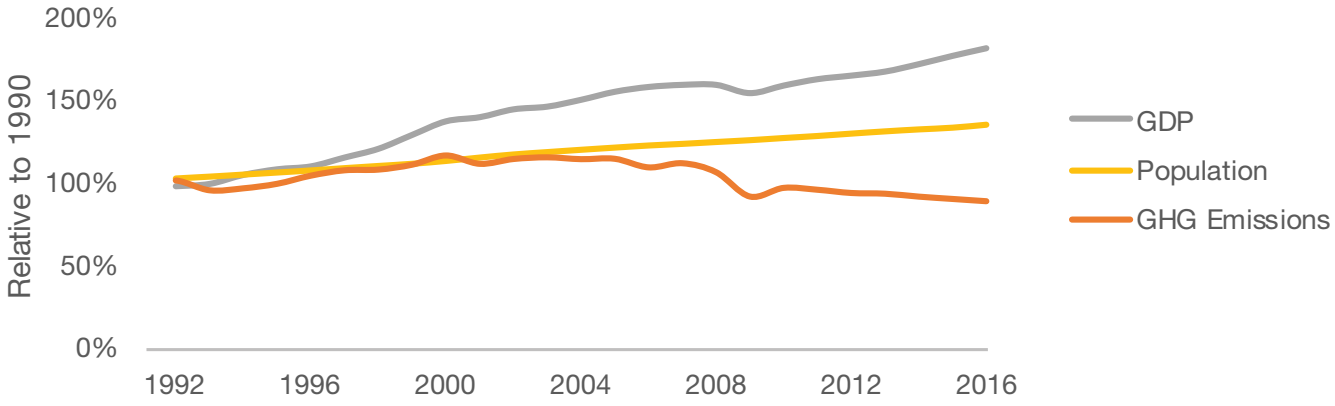
Was Ontario on the right track?

On the whole, yes.

1.3 How Ontario brought emissions down

Ontario became a world climate leader after years of hard work that included:

- closing coal plants
- slowing urban sprawl and promoting conservation
- the 2009 *Green Energy and Green Economy Act*
- the 2016 *Climate Change Mitigation* and *Low-carbon Economy Act* and its cap and trade system
- joining the shared carbon market with California and Quebec, and
- joining the Pan-Canadian Framework on Clean Growth and Climate Change.

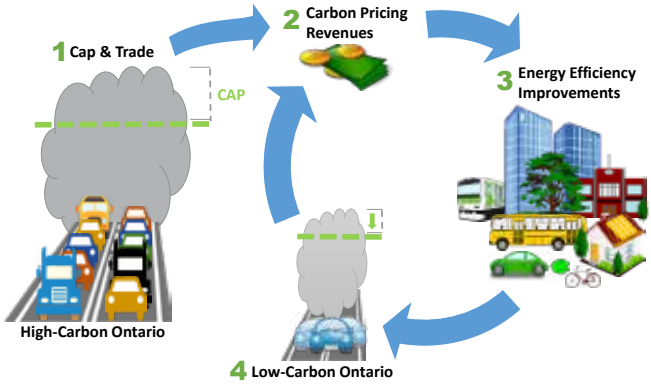


Ontario greenhouse gas (GHG) emissions compared to gross domestic product (GDP) and population trends by year.

Source: Statistics Canada, *Gross domestic product, expenditure-based, provincial and territorial* (2018), CANSIM Table 384-0038; Statistics Canada, Population by year, by province and territory (2018), CANSIM Table 051-0001.

Despite flaws, these were good policies that worked. Ontario's greenhouse gas emissions dropped to the lowest level ever reported, while the economy and population grew.

Cap and Trade Cycle



Cap and trade was providing the motivation and billions in funding for meaningful emission reductions across the province; climate leadership was enhancing Ontario's reputation and drawing in foreign investment. In short, there was some inefficiency, but cap and trade was on its way to producing many economic and environmental benefits for the people of Ontario.

Where are we now?

No climate policy, no emissions targets, no money for solutions. Climate polluters pollute for free. Good conduct is punished and bad conduct is rewarded.

1.4 2018: A wrenching halt

Unfortunately, cap and trade was both complex and poorly communicated; for some, its costs were more obvious than its benefits. Today, cap and trade, the low-carbon programs that it funded, and 752 renewable energy projects have all been swept away, with nothing in their place. The government's proposed replacement, the *Cap and Trade Cancellation Act* (Bill 4), currently lacks most of the features of a good climate law.

Without a strong climate law, Ontario's climate pollution will grow, we will not keep our word, and we will lose out on good jobs, clean air, lower health costs and more.

1.5 Ontario needs climate action

Ontario cannot afford to give up fighting climate change. The window for action is shrinking fast. The sooner we act, the easier and less costly it will be.

The most effective methods of fighting climate change can also improve public health and create good jobs. Today, air pollution from fossil-fueled vehicles is a major threat to air quality and public health in Ontario cities. And Ontarians could make much better use of the $11 billion that we spend every year to import fossil fuels; energy conservation can increase our self-reliance and keep some of that money circulating in Ontario.

Photo credit: Toronto Hydro.

Ontarians need to pull together and protect what we care about.

There are many tried and tested policy options. Ontarians need to pull together and protect what we care about. Government must provide leadership and be clear about the tough decisions, and opportunities, ahead of us. If we choose what seems appealing in the short run, such as reducing the cost of gasoline, we damage our own chances of being winners in the low-carbon economy.

So Ontario again needs a strong climate strategy – one that meets our fair share of Canada's international obligations, reduces our climate pollution, improves air quality and creates good jobs. Ontario must also adapt, i.e., get ready for the climate disruptions ahead.

Why does Ontario need stable climate change policies?

To attract investment and talent, and to give policies time to work.

Part 2: Commitment and credibility

One key feature of an effective climate policy is consistency over time. Transforming Ontario's relationship to fossil fuels is a long-term challenge that requires sustained research, training, innovation, and investment; all are easily disrupted by policy changes.

There is no perfect answer, but the best international model for long-term consistency is the United Kingdom's *Climate Change Act*. The U.K. Parliament sets legally binding long-term emission limits, plus five-year carbon budgets 12 years in advance, based on non-partisan, expert advice and reporting. Ontario should do the same.

The government should consult the people of Ontario.

To make better decisions that people can trust.

Another key feature of an effective climate policy is good consultation with the public, as the *Environmental Bill of Rights (EBR)* requires. For almost 25 years, the *EBR* has provided a solid framework for public consultation on significant environmental decisions, improving the quality of government decisions and increasing public acceptance of their legitimacy.

Photo credit: Toronto Hydro.

Can Ontario meet strong climate targets with existing technology?

Yes, with better government policies.

Part 3: Tools for reducing emissions

3.1 The least-cost pathway

Ontario can still achieve stringent emission reductions by 2030 and 2050.

A detailed model of Ontario's energy system, commissioned by the ECO, shows that Ontario can minimize the cost of reducing emissions by:

- investing in new emissions reduction technologies, including carbon capture and storage, and ways to store carbon in natural systems
- significantly conserving energy and increasing Ontario's clean electricity supply, and
- preparing to minimize fossil fuel use in transportation, buildings and industry.

3.2 The three-legged stool

To get there, government must choose the right policy tools. Like a three-legged stool, effective government policy to reduce greenhouse gas pollution combines:

- taking advantage of the power of the polluter-pay principle (section 3.3)
- unlocking funds for the low-carbon solutions that Ontario needs (section 3.4), and
- regulating climate pollution (section 3.5).

Polluter-pay programs are fair and they work.

3.3 Making polluters pay

The first key element is a "polluter pay" price on carbon or related pollution emitted into the atmosphere. Without it, polluters have no financial incentive to reduce their pollution. Ontario has just given up one version of this tool, but may end up with another if the federal government implements its carbon tax backstop. There are also other variations, such as congestion pricing or feebates.

Without a carbon price, where can the money come from?

Good policies can unlock some public and private funds.

3.4 *Finding ways to pay for solutions*

The second key element is funding to invest in low-carbon solutions. Without the $1.9 billion/year from cap and trade, how can Ontario unlock funds for these solutions, especially if the federal carbon tax does not kick in? We review some other options, including stopping Ontario's subsidies for fossil fuel use.

Without polluter pay, what will drive emissions down?

Regulations will have to do most of the heavy lifting.

3.5 *Regulating climate polluters*

The third key element is regulation of climate pollution, and enforcement of those regulations. In many jurisdictions, regulations do most of the heavy lifting.

Transportation, buildings and waste are key sectors for regulation because emissions from all three sectors have grown since 1990. The strongest regulations directly affect emissions, such as bans, pollution limits or technology or performance requirements. Supplementary regulations may motivate emission reductions, such as reporting and disclosure requirements, and may also facilitate voluntary action.

Photo credit: SimplyCreativePhotography

What can we do to prepare for climate disruption?

Lots, and the province must lead the way.

Part 4: Getting ready for what's coming

Ontario must also prepare for heat, winds, fires, floods, droughts and other extreme events. The costs of adapting to (and coping with) climate disruption could be enormous, and Ontario needs an open conversation on who is going to pay for them. For example, what, if anything, will the government do for property owners or tenants who do not or cannot purchase flood insurance?

In addition, the Ontario government needs to:

- understand Ontario's key vulnerabilities, and protect natural areas that buffer extreme events
- provide trustworthy data on the future climate that new infrastructure must be built for, and
- encourage Ontarians to increase their own resilience to what's ahead.

How can Ontario rebuild its climate policy?

Here's how to start.

Part 5: Summary of key recommendations

The ECO recommends that the provincial government should immediately develop a climate framework with the following central features:

1. **Commit: targets and law**
   a. A climate law that commits the provincial government to a credible, long-term program to achieve statutory emission reductions that:
      i. meets Ontario's fair share of Canada's emission reduction obligations and creates good jobs (sections 1.5 and 3.1), and
      ii. meets the requirements of the Pan-Canadian Framework to unlock federal funds (section 3.3).

   b. Legally binding carbon budgets set well in advance, based on non-partisan, expert advice, coupled with rigorous progress reporting and independent evaluation (section 2.1).

   c. Provincial leadership on adaptation and preservation of natural areas (Part 4).

2. **Plan a pathway**
   a. A transparent, achievable, cost-effective pathway to each carbon budget. The model described in this report is a good start. Note: The lowest-cost pathways require much more clean electricity and storage than the current Long-Term Energy Plan will provide (section 3.1).

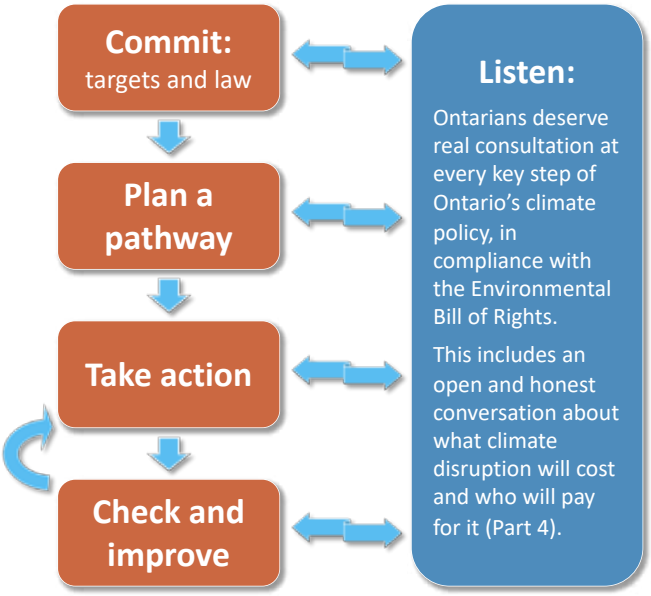
3. **Take action**
   a. Effective policy tools to achieve the necessary emission reductions, using the lowest-cost pathway, public health and ecological integrity to choose priorities. Appendix A contains a convenient menu of the potential tools discussed in this report.

   b. Act fast and take advantage of work already done, here and elsewhere. Ontario is not starting from scratch and does not need to reinvent the wheel. Build on the best of the previous programs. Emphasize efficiency first (e.g., in social housing, schools, hospitals) (section 1.3, Appendix B).

   c. Minimize disruption from the cancellation of previous programs (section 1.4).

4. **Check and improve**
   a. Monitor and report progress to the public, with third-party validation (section 2.2), and

   b. Revise plan and actions as needed to stay on track for targets (section 2.2).



Part 1:
Ontario (again) needs a climate policy

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Climate disruption already affects Ontario, and will get worse.

1.1 Why climate disruption matters in Ontario

Abstract

Climate change is not a distant threat; it is the defining challenge of our time. The planet is warming and Ontario is warming faster than the global average. The historical climate normals that Ontario's economy, agriculture, infrastructure, and standards are based upon are gone.

In Ontario, climate change has affected our health, tourism, infrastructure, economy, environment, food security, recreation and travel. While no impact is due to climate change alone, climate change loads the dice – exacerbating and accelerating impacts on society and our natural and built environments. In the first five months of 2018, extreme weather had already resulted in nearly three-quarters of a billion dollars in insured damage in Ontario. This was followed by a summer of dangerous heat waves, floods, and forest fires in Ontario and around the world. The question now is when and where, not if, Ontarians will feel the consequences of climate change.

The warming in Ontario, and across the world, will continue – bringing with it much more extreme weather. If humans do not dramatically slash global GHG emissions, today's toddlers will live to see severe, widespread and irreversible global impacts, which may go far beyond what they can adapt to.

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1.1.1 What Ontario needs to know about climate change

The basic science

Almost 70 years have passed since the world was first warned about the catastrophic effects of greenhouse gas (GHG) emissions from fossil fuel use on the world's climate. Since then, the issue has been debated at length, science and scientists have been attacked and action has been delayed. Today, there is no longer any legitimate debate over the basic science of climate change. Thirty years of intense work by the Intergovernmental Panel on Climate Change, has proven that climate change is real, serious, happening now and primarily caused by humans. Virtually every climate scientist around the world agrees that GHG emissions, primarily from fossil fuel use and land use changes (i.e., deforestation and urban sprawl), are trapping extra heat in the atmosphere and warming the planet at an extraordinary and dangerous rate.

There is no longer any legitimate debate over the basic science of climate change.

Carbon dioxide (CO_2) is the most important GHG emitted by humans. Unlike other GHGs, CO_2 remains in the atmosphere for a very long time. The amount of CO_2 in the atmosphere is now higher than it has been in at least the last 800,000 years (see Figure 1.1), and way above the level that would permit the world a stable climate. There is scientific consensus that the point at which climate change is irreversible lies between 350 and 400 parts per million (ppm of CO_2 in the atmosphere). In 1988, global CO_2 level passed 350 ppm and, in 2016, the world officially passed the critical threshold of 400 ppm; the global average atmospheric CO_2 concentration in 2017 was 405 ppm (see Figures 1.1 and 1.2).

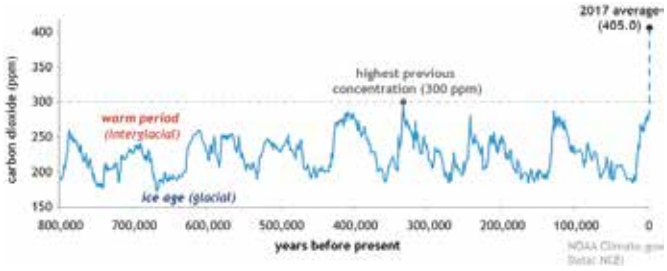

Figure 1.1. Global atmospheric carbon dioxide concentrations in parts per million (ppm) for the past 800,000 years.

Source: National Oceanic and Atmospheric Administration (NOAA), (2018) NOAA Climate.gov.

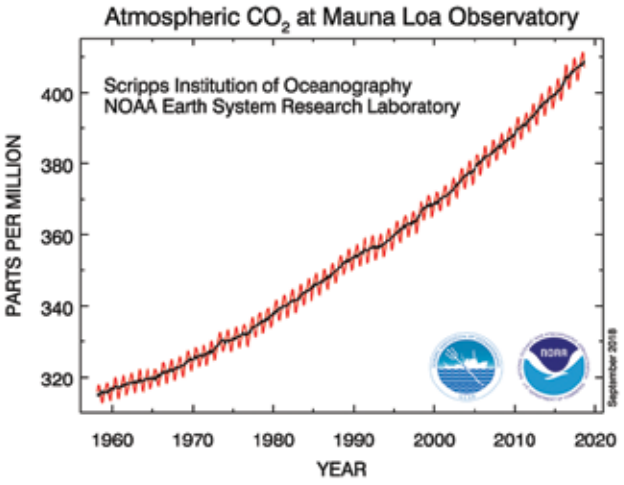

Figure 1.2. Observed atmospheric increase in carbon dioxide.

Source: National Oceanic and Atmospheric Administration (NOAA), Earth System Laboratory, Global Monitoring Division, Trends in Atmospheric Carbon Dioxide at Mauna Loa Observatory (full record), (2016) NOAA Climate.gov.

Meanwhile, humans continue to emit more and more CO_2 every year, as well as other greenhouse gases such as methane (CH_4), nitrous oxide (N_2O) and refrigerants (e.g., chlorofluorocarbons, hydrochlorofluorocarbons, etc.). Changes in land use and land cover (e.g., conversion of wetlands and forests to agricultural land or for development) also continue to affect sources and sinks of GHGs such as CO_2, CH_4 and N_2O. When forests are cut down (e.g., tropical deforestation), the lost trees no longer remove CO_2 from the atmosphere. When forests regrow, as some have in temperate zones, CO_2 can be taken out of the atmosphere and sequestered.

Humans continue to emit more and more CO_2 every year, as well as other greenhouse gases.

Where does the extra heat go?

The GHGs produced by human activity are trapping more heat within Earth's atmosphere every year. About 1% of that extra heat is in the atmosphere, driving up average global temperatures (see Figure 1.3). About 3% of this heat energy is warming the land surface. About 3% is warming (and melting) the world's great ice sheets, raising sea levels. The rest of the heat is in the oceans (mostly the southern oceans near Antarctica, which contains enough ice to drown many of the world's coastal cities). Extra heat damages biodiversity, and makes extreme events more likely and more powerful, including intense heat waves, wildfires, hurricanes, windstorms, and floods. Studies have shown a link between ocean surface temperatures and storm intensity (e.g., hurricanes); warmer air holds (and drops) more water.

Even if humans stopped all emissions tomorrow most scientists agree that, due to the GHGs already in the atmosphere, the world would continue to warm. It will take at least several decades before we experience the full effects of the GHGs that humans have already emitted; meanwhile, emissions continue to grow.

Vital signs of global warming

By 1992, the basic science of climate change was already so clear that Canada, along with almost all other countries of the world, signed and ratified the 1992 United Nations Framework Convention on Climate Change. The objective of the convention is to:

> *Achieve… stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.*

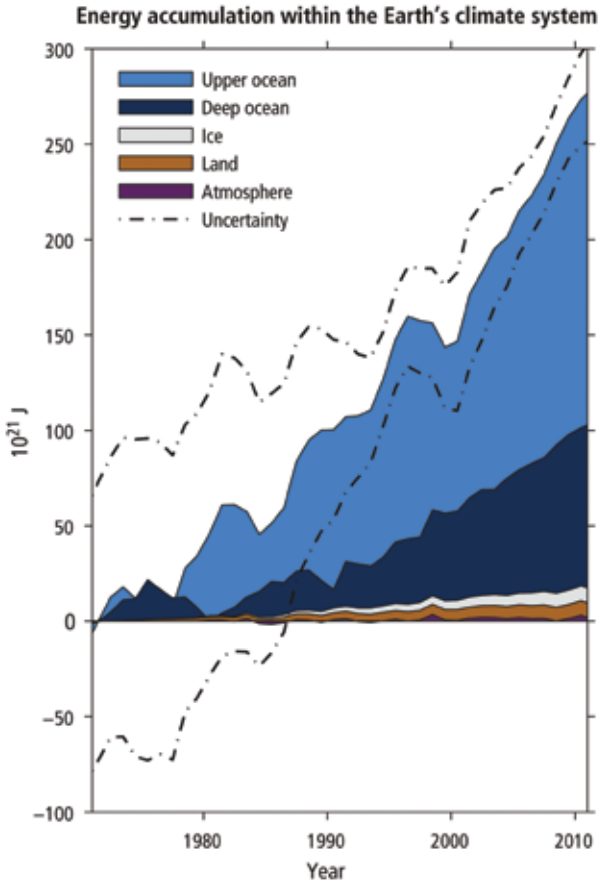

Figure 1.3 Distribution of global heat energy into the world's oceans, ice, land and atmosphere.

Source: Intergovernmental Panel on Climate Change, Chapter 3: Observations: Oceans in Climate Change 2013: The Physical Science Basis (contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change) (2013).

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The five hottest years on record have all occurred since 2010. Globally, 2016 was the warmest year ever recorded.

Since then, GHG emissions and global temperatures have risen, at an increasing pace (see Figure 1.4). The most dramatic warming has occurred since the convention was signed; the five hottest years on record have all occurred since 2010. Globally, 2016 was the warmest year ever recorded. The best available evidence is that, in order to prevent dangerous consequences, the global average temperature increase must be kept well below 2°C compared to pre-industrial levels, and ideally below 1.5°C. As such, countries were asked to strive for these targets as part of the 2015 Paris Agreement. Unfortunately, the world is not on track to achieve either of these temperature targets – yet, global impacts from climate change continue to grow.

This year, New Zealand, Australia, South America, Europe and western United States all experienced some of the highest January temperatures on record. Extreme and deadly heat waves spread across Europe, Asia, Canada, Australia, and the U.S. The African continent witnessed its highest temperature ever recorded, with temperatures soaring to 51.3° C; heatwaves pushed temperatures in Tokyo above 40° C for the first time and temperatures in the Arctic Circle reached 30° C. High temperatures in the Antarctic also led to the second smallest sea ice extent on record.

The Arctic has warmed more than twice as fast as the global average. In January 2018, the Arctic experienced its smallest winter sea ice extent since recording began in 1979. A growing body of research shows that this rapid Arctic warming may already be changing the weather across Europe, North America and parts of Asia.

Rapid Arctic warming may already be changing the weather across Europe, North America and parts of Asia.

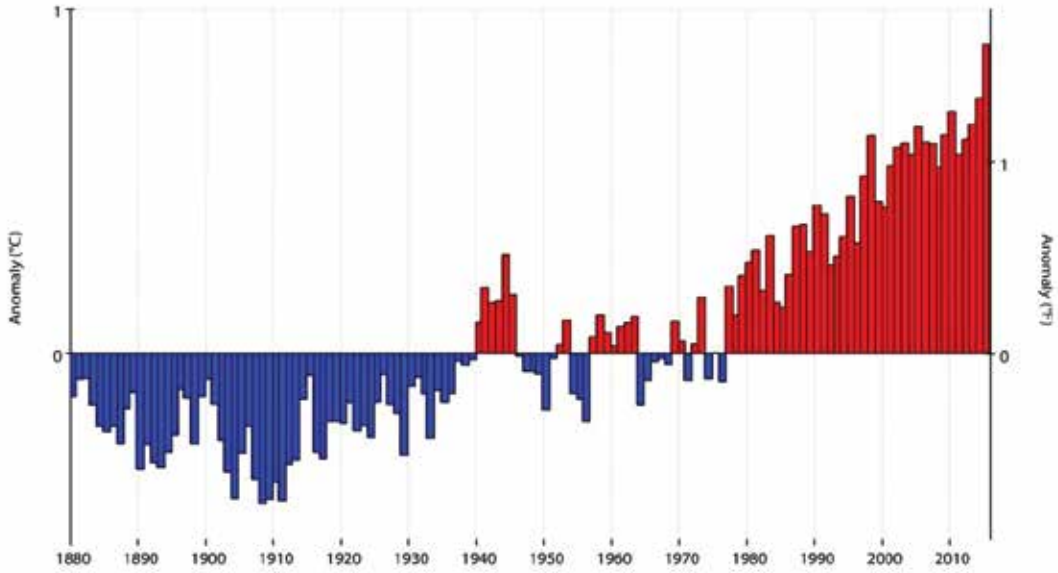


Figure 1.4. Average global temperature difference compared to the long-term baseline averaged over 1901-2000.

Source: National Oceanic and Atmospheric Administration (2018).

The temperature difference between the colder Arctic and the warmer mid-latitude regions is part of what creates the polar jet stream (a belt of moving air that helps create mid-latitude weather patterns) in the northern hemisphere. As the Arctic warms, this temperature difference is being reduced. Early evidence suggests that this reduced temperature difference is responsible for the observed weakening and slowing down of the polar jet stream in recent years. The weakened jet stream allows weather to get "stuck" in one place for longer than it used to, turning sunny days into heat waves, dry conditions into wildfires, wintry days into polar vortexes, and rains into floods. Recent studies also show that over the past 70 years, hurricanes have been lingering over areas for longer periods of time, such as Hurricane Harvey which stalled over Texas for almost a week in August 2017.

In recent years, Ontario has experienced several extreme events due to a weaker jet stream and "stuck" weather patterns, such as the polar vortex of 2014, 2015, and 2017; the 2016 Windsor flood, and the 2017 Quebec and Windsor floods; 2017 "Year of the Big Wet" in Ottawa; and some of the wildfires and heat waves of 2018.

Warmer winters have resulted in an increase in winter flooding. In Ontario, winter flood events have overwhelmed stormwater infrastructure and wastewater treatment plants leading to the direct release of sewage waste into rivers and Lake Ontario. In recent years, First Nation communities along the James Bay coast, already challenged by their location in a floodplain, have been evacuated due to winter flood events caused by heavy rains and early river ice breakup that led to ice jams and overland flooding in local rivers.

Prolonged high temperatures in 2018 also contributed to wildfires in Greece, Sweden, California, Washington, Oregon, British Columbia (B.C.) and Ontario, in some cases resulting in deaths and the destruction of hundreds of homes. In Canada, spring flooding in Alberta, Ontario, B.C., Quebec, and New Brunswick prompted evacuation orders; globally, parts of Japan and India were hit with historic levels of rainfall, triggering large-scale floods, destroying homes and killing hundreds of people. As shown in Figure 1.5, there has been a sustained increase in the frequency of climate extremes and changes in sea level in Canada and the U.S. over recent decades.

Attributing individual extreme weather events to climate change remains a challenge. However, it must be understood that every weather event that happens now takes place in the context of a changing global environment. With such events becoming more common and extreme, government leadership on climate change is more important now than ever.

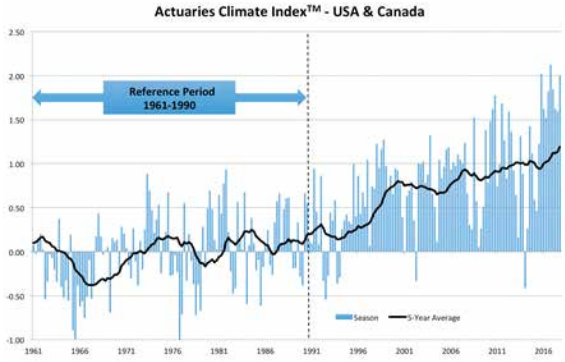


Figure 1.5. The Actuaries Climate Index measures changes in extremes of high and low temperatures, high winds, heavy precipitation, and drought, as well as changes in sea level, expressed in units of standard deviations from the mean for the 30-year reference period of 1961-1990. These values indicate a sustained increase in the frequency of climate extremes and changes in sea levels in Canada and the U.S.

Source: Canadian Institute of Actuaries, 2017.

Ontario is warming faster than the global average.

1

1.1.2 *Ontario's changing climate*

Ontario is warming faster than the global average. Ontario's average annual temperature has already increased by 1.5° C since 1948, and the ten warmest years on record have occurred since 1998. In addition, we know that much more warming is already locked in by the GHGs emitted to date. As a result, the historical climate normals that Ontario's economy, infrastructure, and standards are based on are gone.

How is climate change impacting Ontario? Not only are our summers hotter but our winters are milder, bringing an increase in winter floods and highly variable freeze-thaw cycles. We have also seen frequent and intense weather anomalies, such as prolonged heat waves, droughts, extreme cold events, and intense rainfall and storms. Annual winter ice cover on the Great Lakes has also been reduced. There have been significant fluctuations in water levels in lakes and rivers due in large part to heavy rainfall and urbanization.

By the year 2050, Ontario's average annual temperature is expected to increase by 2.5°C to 3.7°C. Even greater increases are expected in northern Ontario. Precipitation across the province will be variable. Many parts of the province will experience more precipitation than historical levels, particularly in winter; other parts will experience drier summers.

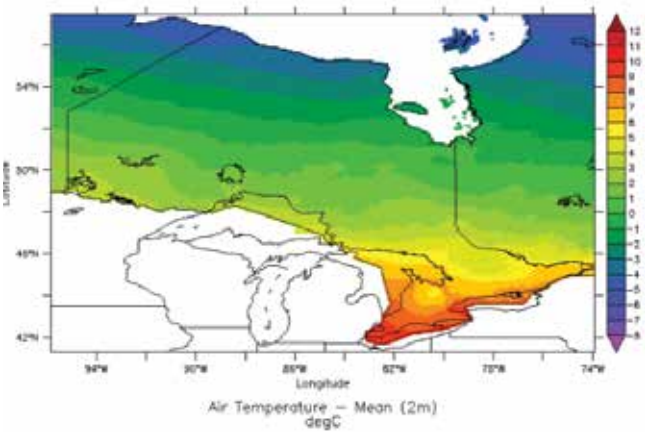


Figure 1.6. Relative annual mean air temperature change in Ontario between 1981-2010 (compared to the 30-year average from 1961-1990).

Source: Natural Resources Canada, 2018. http://cfs.nrcan.gc.ca/projects/3. McKenney et al. 2011.

Figure 1.7. Projected change in Ontario's (a) winter temperatures and (b) summer temperatures for the years 2071-2100 relative to 1971-2000 baseline values. Note: This projection is based on representative concentration pathway 8.5 (warming expected under very high emission scenario due to failure to curb emissions by 2100).

Source: Ontario Ministry of Natural Resources and Forestry (2015).

Ontario's changing climate increases the likelihood of extreme, unpredictable variability in weather.

Snapshot: 2018 weather in Ontario

Ontario's changing climate increases the likelihood of extreme, unpredictable variability in weather patterns, including more intense storms, heat waves, droughts, floods and fires. Extreme weather has already hit Ontario hard this year.

January: In early January, extreme cold temperatures in Toronto required two new warming centres to be opened in the city; by mid-January, unseasonably warm temperatures and heavy rain caused flooding and nearly $10 million in insured damage in Toronto, London and southwestern Ontario.

January – March: Ottawa's Rideau Canal Skateway was repeatedly closed due to a mild winter weather; 2015-2018 skating seasons have been the shortest in the last decade, with the number of skating days significantly reduced.

February: Extreme rainfall caused flooding in southern Ontario, including Chatham-Kent, Cambridge, the Greater Toronto Area, and Brantford; thousands of people were displaced from their homes and there was over $40 million in insured damage.

April: In early April, wind and rain storms in southern Ontario caused $79 million in damage; by mid-April, an unseasonal winter/ice storm in southern Ontario left thousands of people without power and caused $187 million in insured damages.

May: An extreme windstorm, with winds over 100 kilometres per hour (km/h), across several regions of southern Ontario destroyed trees, triggered power outages and caused $380 million in property damage.

June: Eastern Canada, including Ontario, was hit by prolonged and intense heat waves, contributing to more than 70 deaths in Quebec.

July and August: Evacuations and states of emergency declared in communities and provincial parks across northern Ontario (see Figure 1.8) due to wildfires after prolonged periods of severely hot, dry weather and lightning. Special air quality statements were issued for northern Ontario cities. Firefighting costs and resulting damage related to these fires were not yet assessed at the time of writing.

Figure 1.8. Ontario Forest Fire Map on July 23, 2018. Red fire icons represent active fires; orange fire icons represent new fires. Crosshatched area represents restricted fire zones.

Source: Ministry of Natural Resources and Forestry (2018).

Signs of long-term climate change in Ontario: trends and impacts

Long-term shifts in Ontario's climate have already created disturbing trends and impacts. And there are alarming signs that a warming climate in Ontario will make some existing problems worse.

1

Deadly heat waves

- In Toronto, extreme heat contributes to 120 deaths each year
- In Ontario, each 5°C temperature increase in the summer contributes to 4 deaths/day
- Heat-related mortality may double by 2050 and triple by 2080

Tick- and mosquito-borne diseases on the rise

- Milder winters allow black-legged ticks carrying Lyme disease to spread approximately 46 km further north every year through southern and central Ontario (see Figure 1.9)

Long-term shifts in Ontario's climate have already created disturbing trends and impacts.

- Ontario has the highest number of Lyme disease cases in Canada
- The species of mosquito capable of carrying the Zika virus was found in Ontario in 2016
- The number of breeding areas of mosquitos carrying West Nile virus increased from 56 in 2014 to 409 in 2017 (2015-2017 are the hottest years on record)

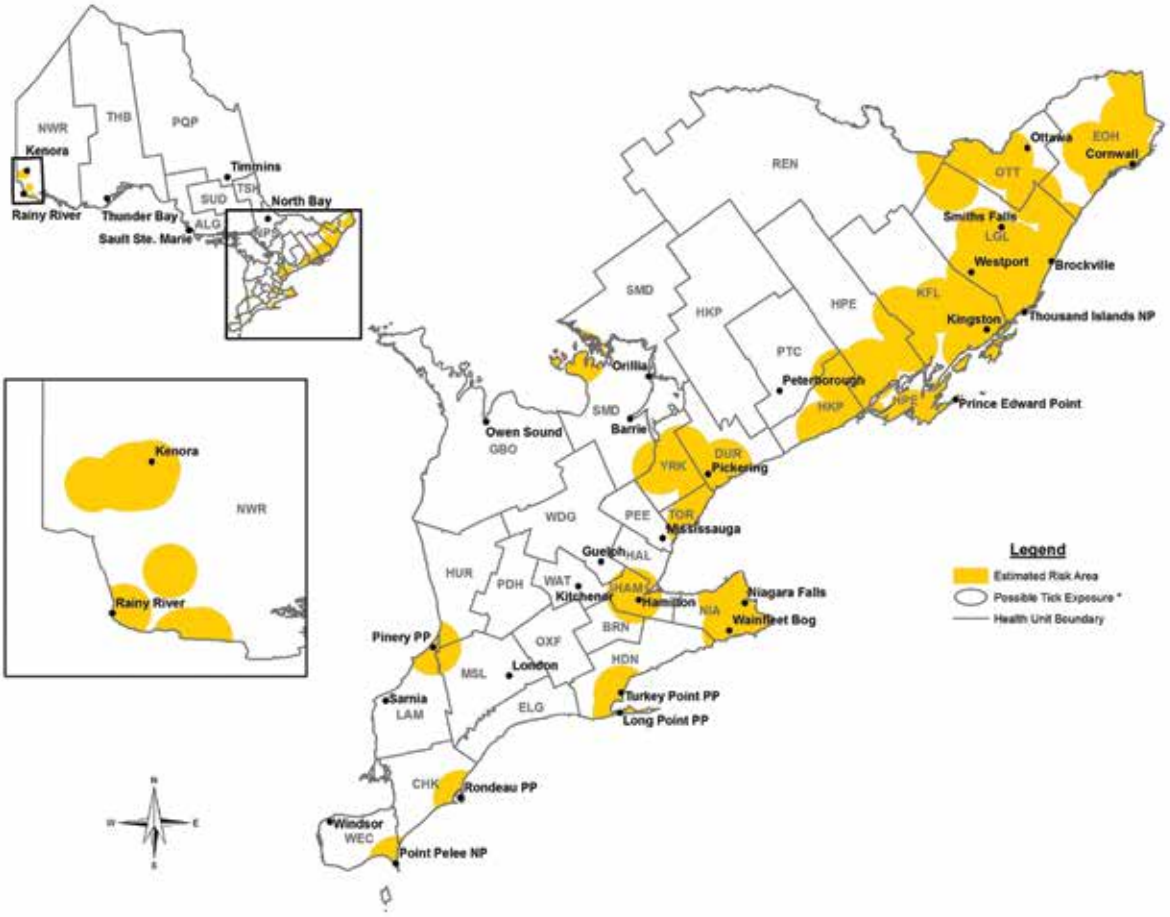


Figure 1.9. Ontario Lyme Disease Risk Map 2018: Estimated Risk Areas.

Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario), Ontario Lyme Disease Estimated Risk Areas Map (Toronto: Queen's Printer for Ontario, 2018). Note: This document was adapted with the permission of Public Health Ontario. Public Health Ontario assumes no responsibility for the content of any publication resulting from translation/changes/adaptation of PHO documents by third parties.

Northern Ontario: warmest

- Warming faster than other parts of Ontario, especially in the winter
- Warmer winters are reducing the length of the winter ice road season (temporary routes over ice, lakes and heavy snow pack), which are lifelines to over 30 First Nation communities that are otherwise landlocked (limits access to food, fuel and construction materials)
- Increase in winter floods due to rapid melting of snow and river ice jams causing evacuations of communities, polluting drinking water and damaging infrastructure
- Milder winters are affecting traditional activities, such as ice fishing

Localized heavy rainfall damage is increasing.

Rain and floods

- Damage from localized heavy rainfall is increasing (see Appendix D)
- Winter floods are increasing in frequency due to more rain and rapid temperature swings during the winter
- Heavy precipitation is contributing to abnormally high water levels resulting in flood damage to properties and infrastructure

April 2018 flood event in Hamilton.

Photo credit: The Hamilton Spectator.

- Stormwater infrastructure has been overwhelmed in several communities including Toronto, Peterborough, London, Peel Region and Halton Region, causing extensive damage from flooding
- Wastewater treatment plants in southern Ontario (e.g., City of Toronto) have been overwhelmed by floodwaters, spilling raw sewage into Lake Ontario

Ontario agriculture: the good and the bad

- Warmer temperatures have extended the growing season; however, production may be limited by water availability
- Crop production is being affected by increasing extreme weather and climate variability
- Between 2010 and 2012, hundreds of dairy cattle died in Ontario because of extreme heat; temperatures over 23°C cause stress for cattle when combined with high humidity and stagnant air
- Current challenges for grape growers, such as early frost damage, severe heat, drought, cooler temperatures and excessive rainfall, may worsen due to future climate change in Ontario
- Expansion of agriculture into northern Ontario may be possible; however, it may be limited by moisture availability and soil quality

Infrastructure: not ready for climate change

- Increased variability in freeze-thaw cycles have caused significant road maintenance issues (e.g., cracks, potholes, etc.), particularly in northern regions of the province
- Sustained heat waves, heavy rain and extreme wind storms have led to an increase in road deterioration, road washouts and disruption to traffic signaling equipment, resulting in road closures and stranded travelers

Increased road deterioration, road washouts and disruption to traffic.

1

- Extreme weather (e.g., heat waves, severe rainstorms, ice storms) in the Greater Toronto and Hamilton Area has affected GO train, subway and other public transit services due to buckling of tracks under extreme heat, flooding, and damage to streetcar wires from extreme wind
- Over 770,000 people affected by utility disruptions from disaster-level extreme weather events in Ontario from 2003-2012

Climate change is a key driver of Canadian food prices.

International food supply and prices

- Climate change is a key driver of Canadian food prices; Ontario and British Columbia are expected to experience above average increases in food prices in the future due in part to the impacts of climate change
- On the Atlantic and Pacific coasts, warming ocean temperatures are driving stocks of popular fish and marine species, such as American lobster and black sea bass northward (12-17 km/decade in last 30 years); habitat shift may compromise the availability of these species
- Significant decline in Pacific salmon stocks and other cold-water species expected by 2050; prices of these fish expected to rise
- Decline in California's crop production due to six-year drought (primary source of Canada's fruits and vegetables); low productivity has raised prices of imported fruits and vegetables in Canada
- Citrus production in Florida has been struggling since 2009 due to spread of new diseases, climate variability, and fires
- Land in major coffee growing regions (Colombia, Mexico, Brazil and Ethiopia) is becoming unsuitable for coffee plants due to shifts in weather patterns

Photo credit: Böhringer Friedrich

- Prices for cooking oils, such as palm oil, has increased due to dry weather in southeast Asia
- 2017 production of wine in western Europe (Italy, France, and Spain) hit historic lows due to unfavourable conditions

Travel and tourism

- Oxygen in lakes and rivers drops as water temperatures increase. This stresses fish, and can lead to fish disease and death. Desirable cold-water fish may be replaced by warm-water counterparts, such as smallmouth bass and black crappie, or less desirable species such as carp.
- Milder winters have shortened seasons for some winter recreational activities, such as skiing and ice fishing, but have lengthened the seasons for activities like golf, hiking, and fishing
- Spread of Lyme disease and West Nile virus continues to affect travel within Ontario.
- The spread of vector borne diseases to holiday destinations for Canadians (e.g., Caribbean and central America) has resulted in cases of malaria, dengue fever and Chikungunya virus in Canada.

Oxygen in lakes and rivers drops as water temperatures increase.

- Since 2015, the number of travel-related cases of Zika virus infection in Canada has increased; in 2018, there were 568 travel-related cases of Zika in Canada

1.1.3 Financial costs of climate change to the people of Ontario

The damage caused by floods, some the result of record-setting rainfalls, is a reality that many Ontarians are already experiencing first hand (see Figure 1.10). Some of these flooding events come with substantial economic costs; insured damage from the 2013 Toronto floods totalled $940 million, making it the costliest insured disaster in Ontario's history. In 2014, an extreme rainfall event in Burlington flooded roads and highways along with more than 3,000 homes, ultimately costing $90 million in insured damage.

Flooding also significantly impacts the environment. The 2013 Toronto flood overwhelmed the city's wastewater treatment plants and stormwater systems, resulting in up to a billion litres of sewage, as well as garbage and debris, being washed into Toronto's rivers and Lake Ontario. High-volume stormwater flows also cause riverbank and shoreline erosion.

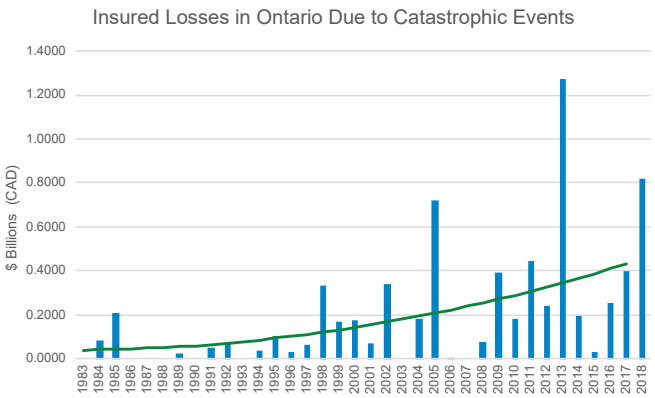


Figure 1.10. Record of losses greater than $25 million due to catastrophic events (e.g., earthquakes, fires, hail, wind, water, ice, snow, lightning) in Ontario between 1983 to 2018. Values in 2017 Canadian dollars. Values for 2018 are preliminary. Includes insured losses from personal and commercial property, and automobile damage. Excludes adjustment expenses. Green line is an estimated trend.

Source: IBC Facts Book, CatIQ, PCS, Swiss Re, Munich Re & Deloitte (2018).

The flooding of the Toronto Islands during the spring and summer of 2017, when lake levels hit a historical high-water mark, has cost the city approximately $16 million so far, and an additional $25 million will be needed over the next ten years for long-term repair and resilience measures. Flooding in Windsor in 2017 resulted in over $124 million in insured flooding damage.

Ontario's northern communities are particularly vulnerable to flood events, especially those that do not benefit from the flood management provided by conservation authorities. For example, the Town of Wawa was stranded when a catastrophic storm in 2012 washed-out parts of the Trans-Canada highway, in addition to roads, houses and businesses; resulting in $20 million in damages. In January 2018, winter floods (e.g., melting snow, ice jams, and rainfall) caused over $12 million in insured damage in Ontario.

The gap between insured and uninsured losses is significant.

Ontario taxpayers bear some of the brunt of the uninsured costs of storms, as well as significant personal losses (e.g. $60 million losses were uninsured from the 2013 Toronto flood event). As shown in Figure 1.11, the gap between insured and uninsured catastrophic losses is significant across Canada.

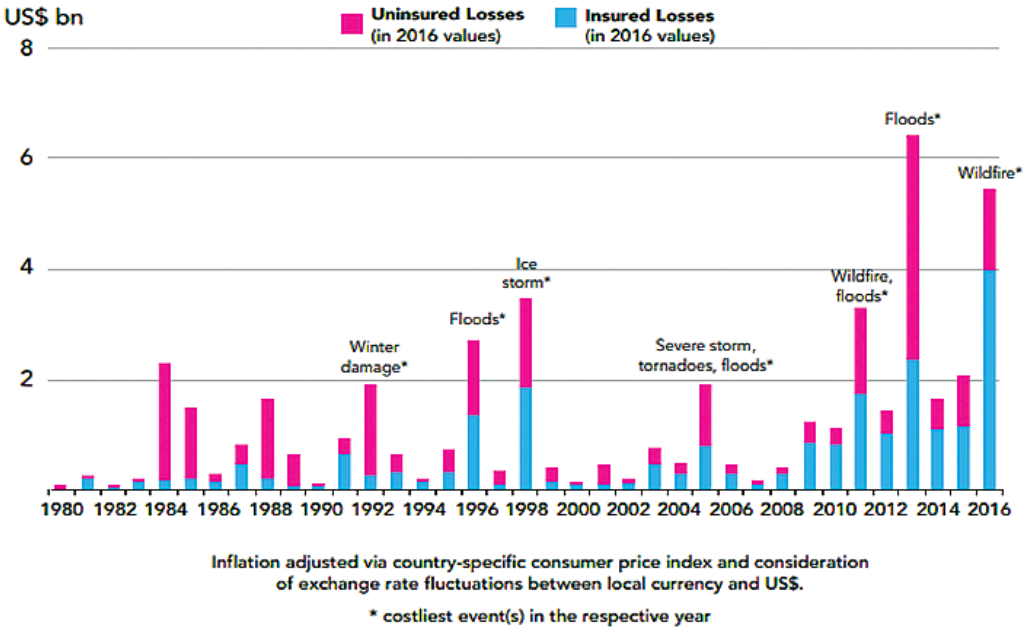


Figure 1.11. The gap between insured and uninsured catastrophic losses in Canada (1980-2016).

Source: Munich Re, Geo Risks Research, NatCatSERVICE (2017).

Intact Financial, one of Canada's largest property insurers, is reported to have raised premiums by as much as 15-20% in response to increasing costs of weather-related property damage. The Insurance Bureau of Canada (IBC) estimates that up to 10% of Canadian properties may soon be too high risk to be insured by the private sector if no measures are taken to mitigate flood risk by the owner or through public policy. The IBC asserts that improved infrastructure and flood risk mitigation by governments, including investments in natural infrastructure (such as wetlands), along with stronger land use planning, building codes and public awareness, could help improve insurability and community flood resiliency.

Over 130,000 buildings and over 21,000 hydraulic structures, such as bridges, are in known floodplains.

Some floods occur in floodplains when rivers overflow. Based on current floodplain maps, the Greater Toronto Area alone has 42 heavily occupied known flood-risk areas within communities such as Malton, Etobicoke, Brampton, Woodbridge, Bolton, Maple, Thornhill, Markham, Unionville, Stouffville and Pickering (see Figure 1.12). Conservation Ontario estimates that over 130,000 buildings and over 21,000

hydraulic structures, such as bridges, are in known floodplains. Although, floodplain mapping for the Greater Toronto Area's flood-risk areas is kept relatively up-to-date, 74% to 78% of floodplain maps in Ontario, where conservation authorities exist, require updating. These outdated floodplain maps are incomplete, and do not reflect the patterns of growth that have happened over recent decades, which have changed surface water flows.

In recent years, extreme floods have also occurred outside of floodplains (e.g., August 2017 rainfall event that flooded more than 5,000 homes in Windsor and Essex County). Given future development pressures, the lack of knowledge about Ontario's flood hazards exposes the public, buildings and infrastructure to significant flood risks. The Insurance Bureau of Canada has reported that there "has been a rise in claims as result of increases in severe weather events related to climate change" over the past few years.

74% to 78% of floodplain maps in Ontario, where conservation authorities exist, require updating.

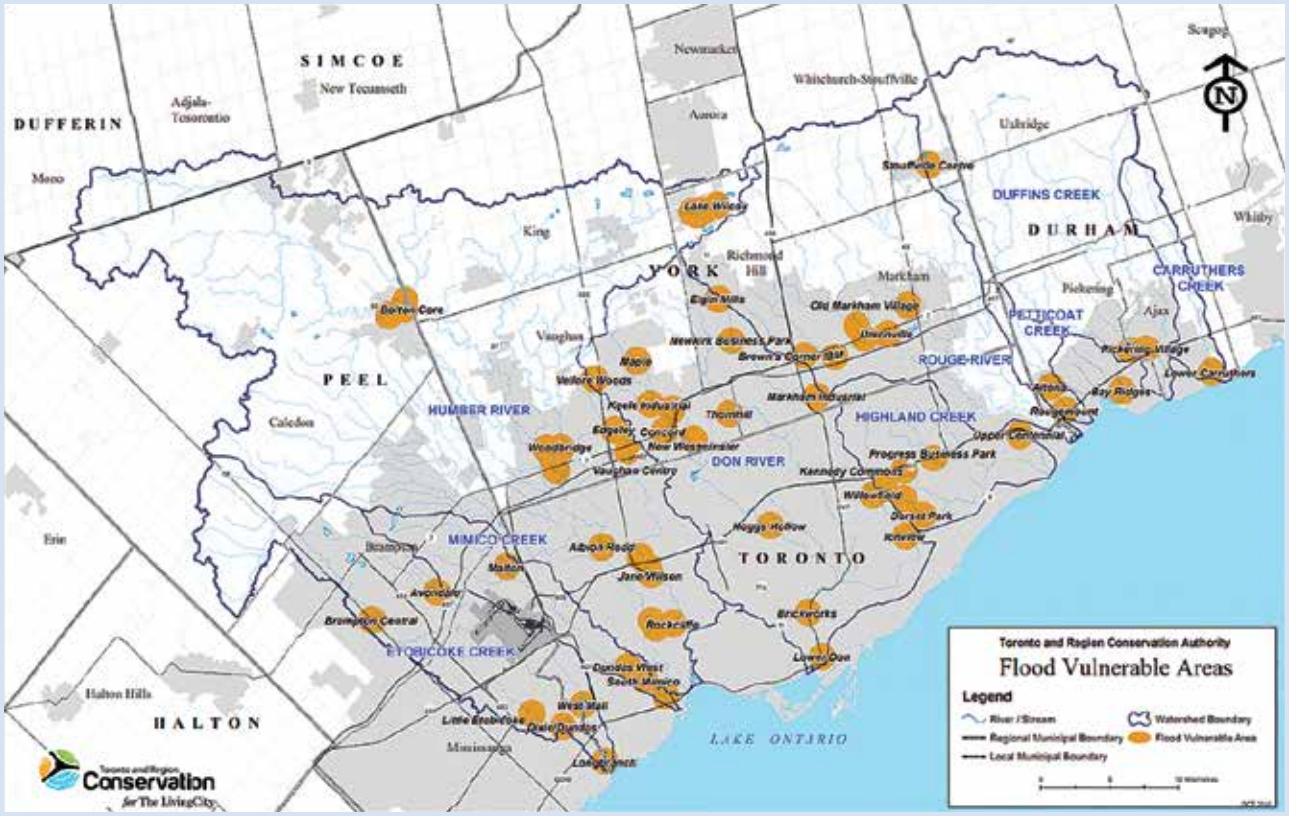


Figure 1.12. Toronto river flood vulnerable areas. Note: The flood-vulnerable clusters depicted are general locations only, and are locations which contain a high concentration of vulnerability to riverine flooding. For detailed information about the flood vulnerable clusters, please contact TRCA Flood Risk Management staff.

Source: Courtesy of Toronto and Region Conservation Authority (TRCA), 2012.

In addition, wildfire has also been a major contributor to catastrophic insured and uninsured losses in Canada (see Figure 1.11). In Canada, the summers of 2017 and 2018 were marked by historic wildfires across British Columbia, causing evacuations and states of emergencies to be declared.

Wildland fire management costs have been steadily rising.

Over the last several decades, wildland fire management costs have been steadily rising by about $120 million per decade in Canada, reaching annual values of $1 billion in recent years. Climate change projections indicate that the frequency and severity of forest fires in Canada are expected to increase due to climate change. Smoke from wildfires is one of the most serious air quality problems for Canadians, especially given the long distances that the smoke can travel (see Figure 1.13). The smoke contains small particles, carbon monoxide, volatile organic compounds and other ozone-producing gases, all of which can trigger or worsen health problems such as asthma and heart disease (see Figure 1.14).

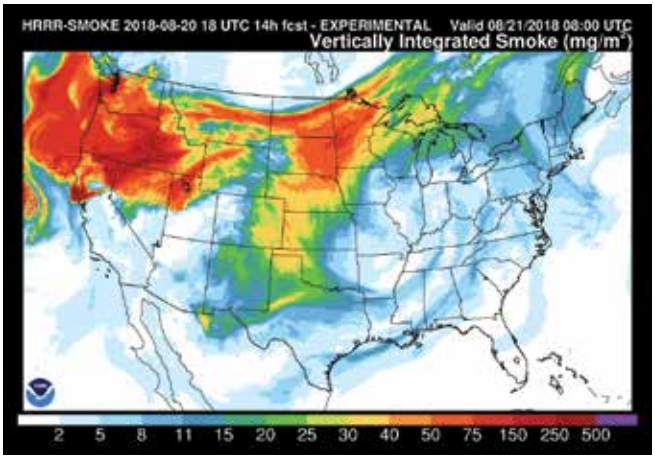


Figure 1.13. Smoke from fires in northern California, Oregon, Washington State, and British Columbia on August 21, 2018, affected large areas of North America, including Ontario.

Source: National Oceanic Atmospheric Administration (NOAA), 2018.

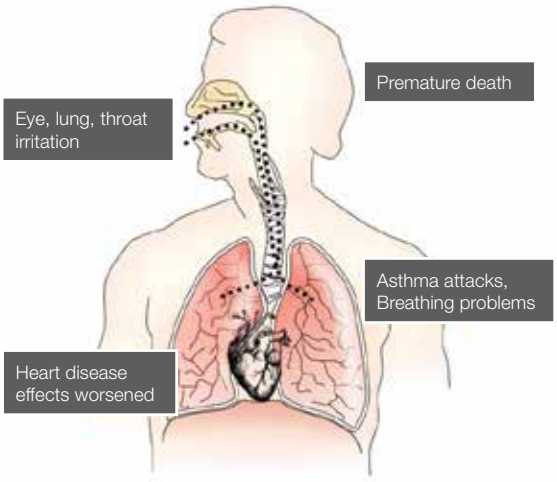


Figure 1.14. How wildfire pollution harms health.

Source: Environmental Commissioner of Ontario. Inspired by Climate Central (2018).

Insurance losses are rising steeply.

1.1.4 What climate change is costing the federal and provincial governments

Climate change is now an urgent and growing threat to human health, homes, infrastructure, and natural areas in Ontario and Canada. In 2016, the federal Commissioner of the Environment and Sustainable Development reported that "severe weather events have resulted in rising costs to governments at all levels in Canada and, by extension, to all Canadians."

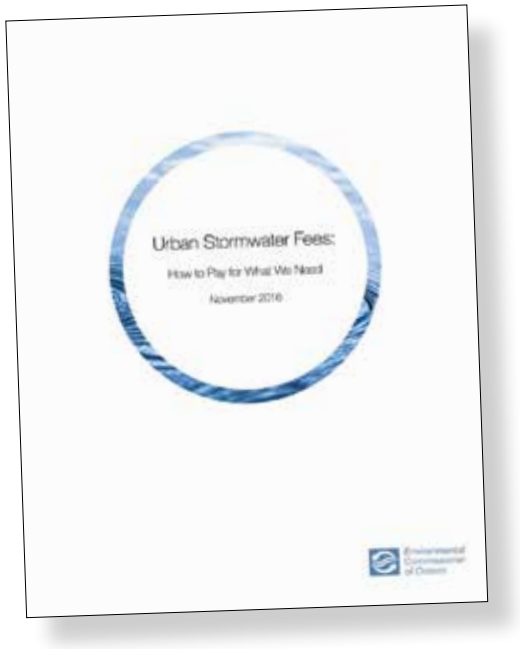
The Government of Canada identifies flood events as the most costly natural disaster in terms of property damage – next to spring snowmelt, heavy storm rainfall is the most common cause of flooding. To help provinces and territories better understand

Flood events are the most costly natural disaster.

flood risks and develop strategies for reducing the impacts of floods, the federal government created a National Disaster Mitigation Program (NDMP) in 2014. Since 2016, there have been 131 flood-related projects in Ontario that are funded by the NDMP. This program builds on the government's Disaster Financial Assistance Arrangements fund (DFAA), which was established in 1970 to provide financial assistance following disasters and extreme weather events. Between 1970 and 2014, roughly three-quarters of DFAA's costs were related to floods.

In 2018, the federal government launched a Disaster Mitigation and Adaptation Fund, a 10-year national program that will invest $2 billion in projects that help communities reduce the impacts of climate change and better protect Canadians against disasters such as floods, wildfires, and droughts. Overall, federal government disaster relief spending has risen from an average of $40 million a year in the 1970s to an average of $100 million a year in the 1990s. Spending has continued to rise sharply, hitting a record of $1.4 billion in 2013. The province of Ontario has provided further support through two disaster recovery programs (Disaster Recovery Assistance for Ontarians and the Municipal Disaster Recovery Assistance). Despite these efforts, in 2017, the Ontario Auditor General reported that Ontario's overall state of readiness to respond to emergencies (i.e., floods, severe weather events, public health crises and others) needs significant improvement.

The increasing trend in flood-related damages is due not only to the increasing frequency and severity of flood-related events that climate change brings (see Appendix D). Other factors include urban sprawl, which increases runoff; increasing value concentration in high-risk areas; deteriorating infrastructure; and a lack of action on stormwater management (e.g., land use planning, low impact development technologies, stormwater fees, etc.) (See the ECO's 2016 Special Report, Urban Stormwater Fees: How to Pay for What We Need.)



1.1.5 The squeeze on municipalities

Municipalities are often the first to feel the impacts of climate change, such as floods, heat waves, ice storms and public health crises. Municipal governments bear the responsibility of preparing and protecting communities against these impacts, and bear significant costs after a disaster happens.

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Many of the climate assumptions on which our communities and infrastructure were built are no longer accurate.

Many of the climate assumptions on which our communities and infrastructure were built are no longer accurate. Ontario's buildings, roads, farms, sewers and electricity distribution systems were all designed based on historical climate information. Extreme weather has created many new challenges for Ontario municipalities, including:

- evacuations and population displacement
- disruption of services and damage to critical infrastructure
- business interruption due to lack of resources to handle growing issues, and
- emergency response and threats to public health.

Ontario municipalities are also struggling to pay for the maintenance and replacement of aging infrastructure, much of which is unable to cope with new temperature extremes and storm surges. The costs of replacing poor and very poor infrastructure across Canada is estimated to be $141 billion.

2013 Flood event in the City of Toronto.

Photo credit: Toronto Hydro.

Extreme weather is also fueling lawsuits against municipalities, conservation authorities and the province for damages and costs. For example, in 2010, the City of Stratford paid $7.7 million to settle a class action lawsuit brought on by residents who were flooded in a 2002 storm. In 2016, a class action lawsuit was launched by Muskoka residents and business owners against the province due to damages caused by flooding and high water levels.

Climate disruption has already arrived in Ontario, and much more is ahead.

1.1.6 Conclusion

Climate disruption has already arrived in Ontario, and much more is ahead. Even at current global GHG emission rates, today's toddlers can expect to face temperature increases in Ontario during their lifetimes similar to those that ended North America's last ice age (average increase of 4°C-7°C). Such increases would cause severe, widespread and irreversible impacts, far beyond what they may be able to adapt to. Whether we want to believe it, or not, the actions we take now to reduce GHG emissions really matter to our future and to the future of generations to come. Every tonne counts, and every action matters.

For Ontario and the world, the tipping point has been reached. With every day that passes, our emissions continue to climb and the challenge becomes more difficult. To safeguard Ontarians from the dangers posed by climate change and to ensure that the danger does not grow, Ontario must take aggressive and sustained climate action.

Every tonne counts, and every action matters.

1.2 Ontario's greenhouse gas emissions were dropping

Abstract

Ontario's greenhouse gas (GHG) emissions in 2016 were the lowest since reporting began in 1990. This continues the recent downward trend in emissions that allowed Ontario to meet a 2014 emissions-reduction target of 6% below 1990 levels. However, this past success was largely a result of closing Ontario's coal power plants. Non-electricity GHG emissions must fall in order for Ontario to make further emission reductions.

Contents

1.2.1 Greenhouse gas emissions were dropping

Greenhouse gas (GHG) emissions in Ontario in 2016 were the lowest since reporting began in 1990. According to the National Inventory Report, which provides the most recent data, emissions in 2016 were 161 megatonnes of carbon dioxide equivalent (Mt CO_2e), 10% below those in 1990, as shown in Figure 1.15. GHG emissions in 2016 were 23% below their historical peak, which occurred in 2000, and 3% below the emissions in 2009 during the depths of the economic recession.

Greenhouse gas (GHG) emissions in Ontario in 2016 were the lowest since reporting began.

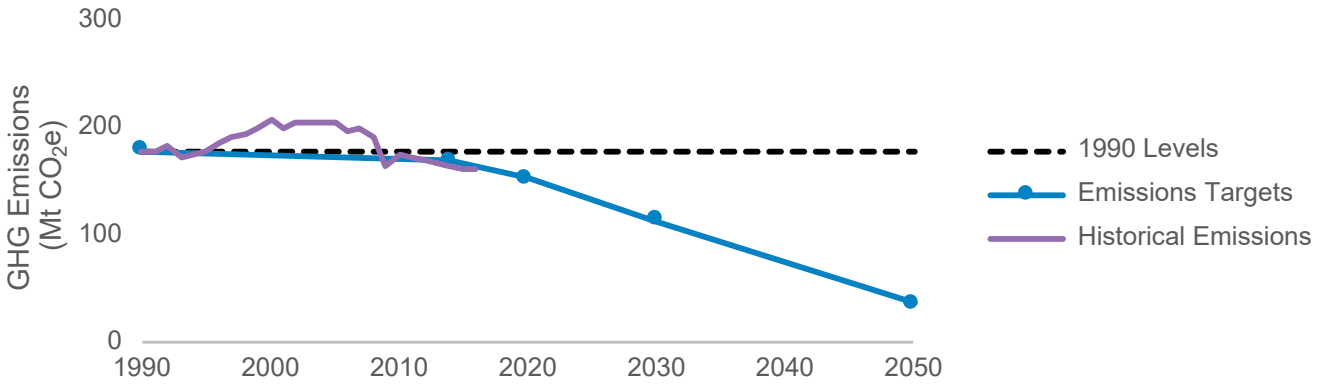

Figure 1.15. Ontario's historical greenhouse gas emissions (GHG) and emission reduction targets (established pursuant to the *Climate Change Mitigation and Low-carbon Economy Act*).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A11-12, page 29.

In 2007, Ontario set three GHG emission reduction targets compared to 1990 levels. The province achieved its first target of a 6% reduction by 2014 (Figure 1.15). This success was largely a result of the phase-out of coal for electricity generation completed in 2014. This allowed emission reductions at the same time as the economic and population growth shown in Figure 1.16.

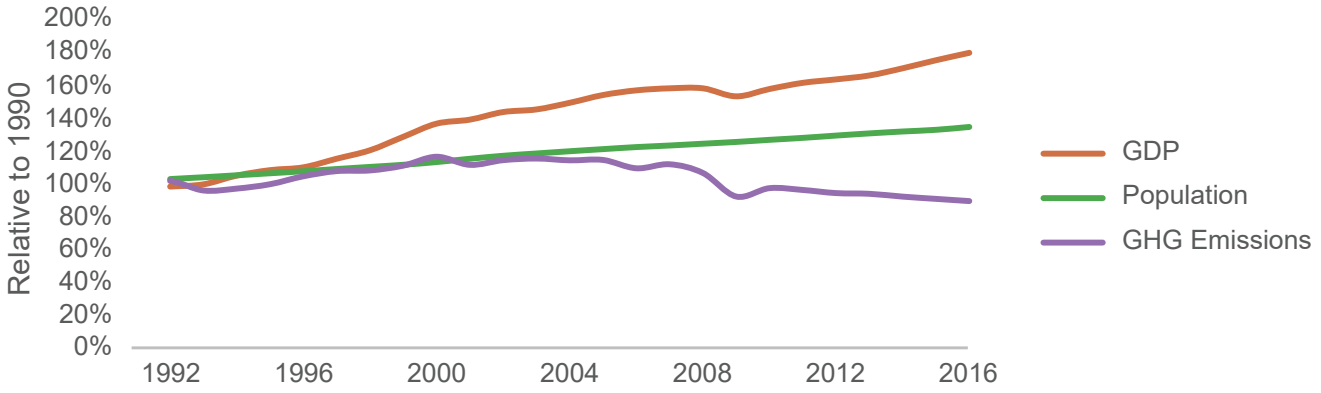

Figure 1.16. Ontario's historical greenhouse gas (GHG) emissions relative to gross domestic product (GDP) and population.

Source: Statistics Canada, *Gross domestic product, expenditure-based, provincial and territorial* (2018), CANSIM Table 384-0038; Statistics Canada, *Population by year, by province and territory* (2018), CANSIM Table 051-0001.

Continuation of this successful trend will be challenging. Ontario's ability to reduce electricity sector GHG emissions has been nearly exhausted, as shown in Figure 1.17.

In contrast, Ontario's non-electricity GHG emissions were 2% higher in 2016 than in 1990. These include emissions from the transportation, industry, buildings, agriculture and waste sectors. Thus, non-electricity GHG emissions must fall in order for Ontario to make further emission reductions. Most Ontario programs to reduce these emissions were funded from the now-cancelled cap and trade program under the *Climate Change Mitigation and Low-carbon Economy Act*.

Non-electricity GHG emissions must fall in order for Ontario to make further emission reductions.

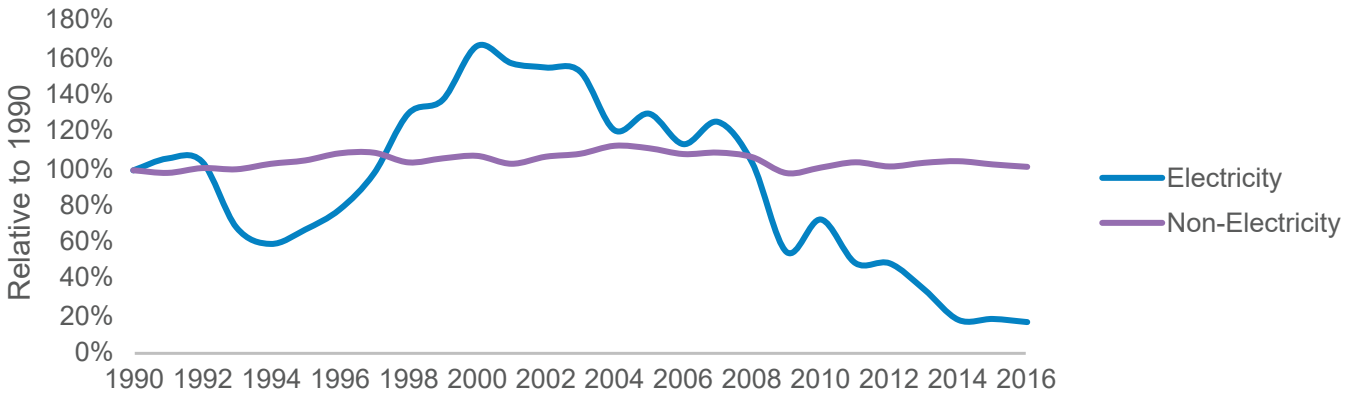

Figure 1.17. Ontario's historical electricity and non-electricity greenhouse gas emissions relative to 1990 levels.

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A11-12, page 29.

Unfortunately, as discussed in Chapter 3 of the ECO's 2016 Greenhouse Gas Progress Report, and further examined below, Ontario's emissions as reported in the National Inventory Report underestimate the climate change impact of methane. This means that both the contribution from methane, and the climate damage that methane causes, are higher than those reported.

1.2.2 Which greenhouse gases are reported?

The United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty that determines which GHG emissions are reported. The reported emissions, shown in Figure 1.18, are carbon dioxide (85% of Ontario's reported total), methane (7%), nitrous oxide (5%), hydrofluorocarbons (3%), sulphur hexafluoride (0.2%) and perfluorocarbons (0.005%).

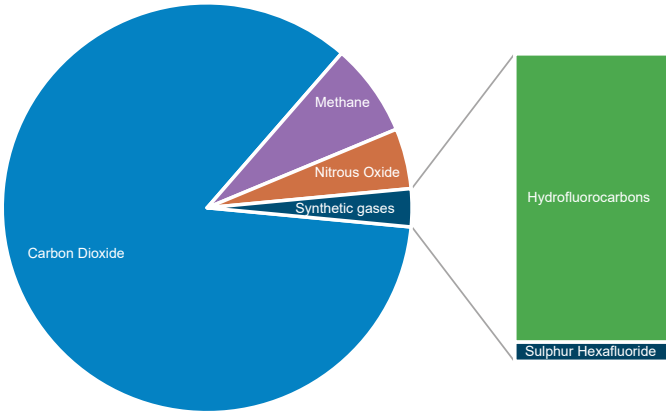

Figure 1.18. Ontario's 2016 greenhouse gas emissions by greenhouse gas type, based on carbon dioxide equivalents. Hydrofluorocarbons are mostly refrigerants. Perfluorocarbons are synthetic gases that are not visible in the figure due to their relatively small quantities.

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A11-13, page 30.

International guidelines also determine how each GHG emission is reported. Each GHG has a somewhat different effect on climate change and lasts a different period of time in the atmosphere. Each type of gas is weighted by its ability to trap heat over a period of time, as compared to carbon dioxide. Global warming potentials (GWPs) are the weighting factors used to allow comparisons between different types of gases.

The international community uses the 2007 Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) estimate of 100-year GWP. The choice of both this report and a 100-year timeframe underestimates the climate damage of methane. The IPCC has since released a Fifth Assessment Report (AR5) with a higher 100-year GWP for methane. Additionally, methane is a short-lived climate forcer, which means its GWP is much higher during the comparatively short time (12.6 years) it is in the atmosphere. In other words, using the 100-year GWP (which mathematically "spreads out" this 12.6-year impact over 100 years) dramatically understates the true climate damage of methane emissions in the next critical decade or two.

The true climate damage of methane is dramatically understated.

The impact on Ontario's GHG emissions of recognizing this huge short-term effect (using a 20-year GWP) is shown in Figure 1.19. All other figures in this chapter are produced using the official GHG emission estimates from the National Inventory Report.

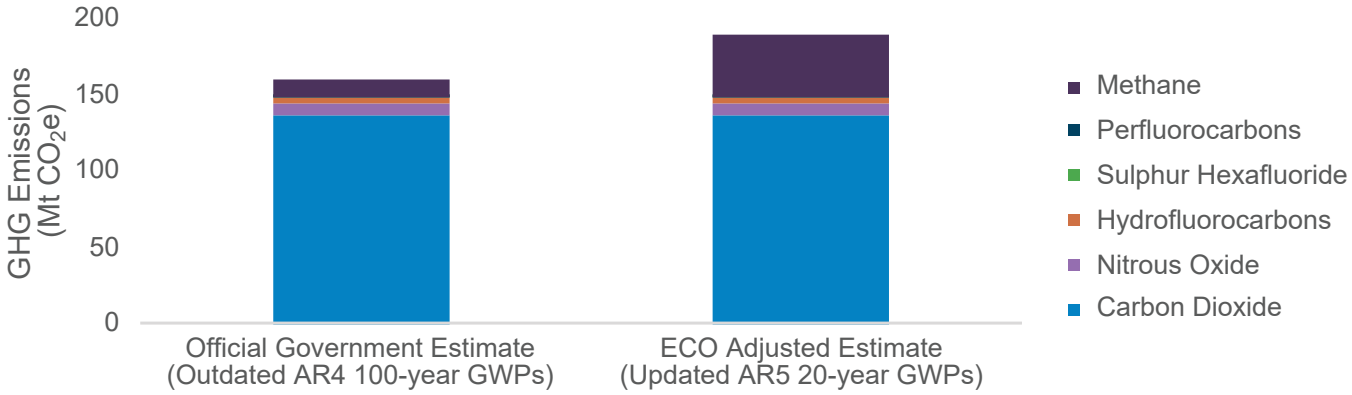

Figure 1.19. Official and revised estimates of Ontario's 2016 greenhouse gas (GHG) emissions showing the impact of using different methane global warming potentials (GWPs).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A11-13, page 30.

1.2.3 How are emissions produced?

In accordance with international rules, the National Inventory Report classifies Ontario's sources of GHG emissions into four IPCC sectors: *energy, agriculture, waste,* and *industrial processes and product use.*

Energy use resulted in 75% of Ontario's 2016 GHG emissions. This was primarily from the burning of fossil fuels for transportation and heating, but also from venting and leakage of natural gas. These emissions were primarily in the form of carbon dioxide, with some methane and nitrous oxide emissions, as shown in Figure 1.20.

Agricultural practices produce emissions from animal digestion, manure, soil and fertilizer use. These produced 6% of emissions, mostly in the form of methane and nitrous oxide.

Waste management produces emissions from decomposition and incineration. These were responsible for 4% of the emissions and were predominantly methane.

Industrial processes and product use result in emissions from physical and chemical reactions. These emissions were 15% of the emissions, and were mostly carbon dioxide but also include smaller quantities of synthetic gases. Hydrofluorocarbons (e.g., from use as a refrigerant), perfluorocarbons (e.g., from use as a solvent) and sulphur hexafluoride (e.g., from use as an insulating gas) were the synthetic gases emitted.

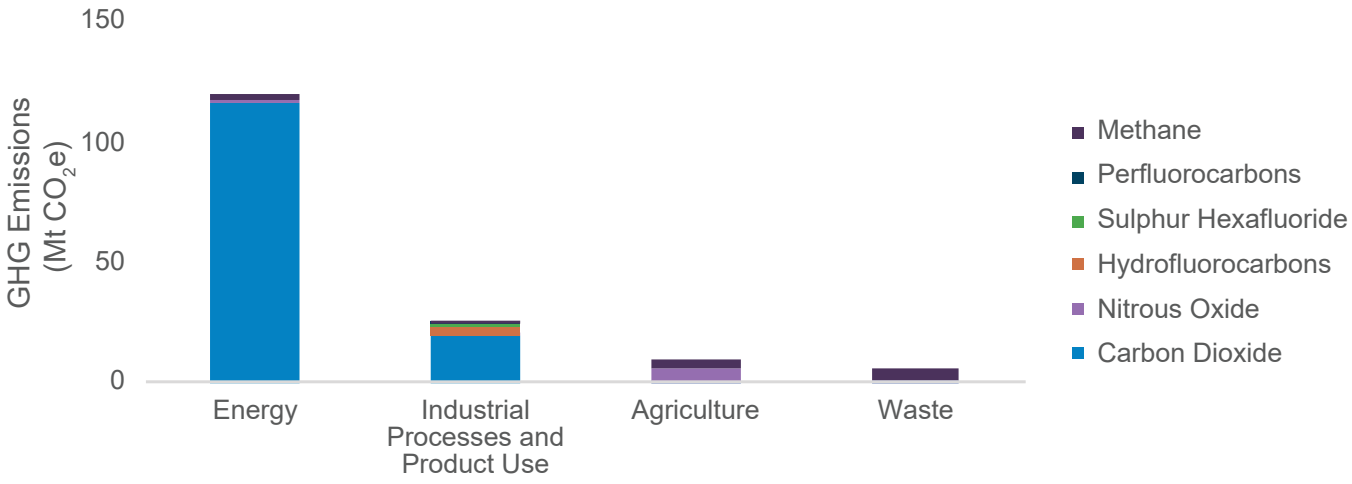

Figure 1.20. Ontario's 2016 greenhouse gas (GHG) emissions by Intergovernmental Panel on Climate Change sector (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A11-13, page 30.

1.2.4 Economic sectors

The Government of Canada is required to report GHG emissions in accordance with international guidelines using the IPCC sectors introduced above in Figure 1.20. However, this is not an intuitive approach. Many people find it easier to understand GHG emissions based on economic sectors. In the economic sector approach, emissions from driving farm tractors are attributed to the *agriculture* sector, as opposed to the *energy* sector. Similarly, emissions from a car's air conditioner are attributed to the *transportation* sector rather than to *industrial processes and product use*. Figure 1.21 illustrates how Ontario's GHG emissions can be reorganized into economic sectors.

Many people find it easier to understand GHG emissions based on economic sectors.

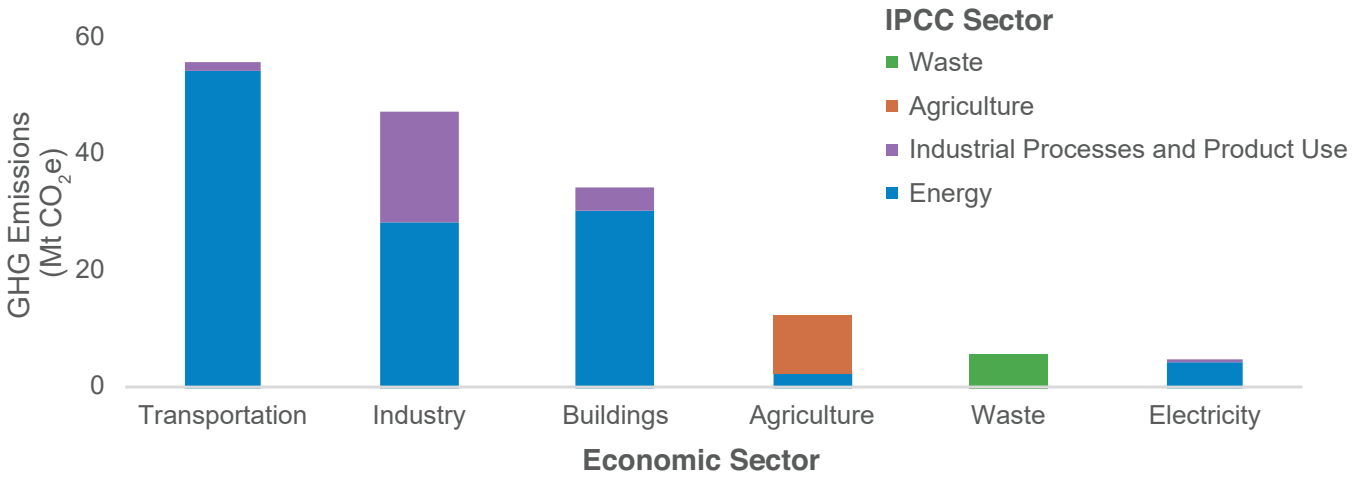

Figure 1.21. Ontario's 2016 greenhouse gas (GHG) broken down emissions by Intergovernmental Panel on Climate Change (IPCC) and economic sectors (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), supplemental data provided to the ECO.

The transportation sector is the largest contributor to Ontario's GHG emissions.

The transportation sector is the largest contributor to Ontario's GHG emissions (35%), followed by industry (30%), buildings (21%), agriculture (8%), waste (4%) and electricity (3%). The emissions from each of these economic sectors and their subsectors are compared with those in previous years in Table 1.1. Each economic sector is analyzed below using insights and historical data from the National Inventory Report unless otherwise specified.

Table 1.1. Ontario's 1990, 2015 and 2016 greenhouse gas (GHG) emissions in megatonnes of carbon dioxide equivalent ($Mt\ CO_2e$) by economic subsectors.

GHG Emission Sources	Emissions ($Mt\ CO_2e$)			Change (%)	Share of Total (%)	
	1990	2015	2016	1990-2016	2015-2016	2016
Transportation	**42**	**56**	**56**	**34**	**0**	**35**
Passenger Transport	25.5	33.2	33.9			
Cars, Light Trucks and Motorcycles	23.5	31.0	31.7			
Bus, Rail and Domestic Aviation	2.0	2.2	2.2			
Freight Transport	8.4	18.8	18.3			
Heavy Duty Trucks, Rail	7.0	17.3	16.9			
Domestic Aviation and Marine	1.4	1.5	1.4			
Recreational, Commercial and Residential	7.7	3.6	3.6			
Industry	**66**	**47**	**48**	**-28**	**0**	**30**
Heavy Industry	43.1	28.6	30.0			
Iron and Steel	15.0	12.4	13.7			
Chemicals & Fertilizers	16.2	7.3	7.2			
Cement	4.5	4.2	4.2			
Pulp and Paper	3.2	1.7	1.9			
Mining	1.0	1.2	1.3			
Lime & Gypsum	1.7	1.1	1.1			
Smelting and Refining (Non Ferrous Metals)	1.5	0.7	0.7			
Oil and Gas	10.3	10.1	9.4			
Petroleum Refining	6.6	7.3	7.0			
Oil and Natural Gas Transmission	3.0	2.1	1.7			
Natural Gas Distribution	0.4	0.5	0.5			
Natural Gas Production and Processing	0.3	0.2	0.2			
Conventional Oil Production	0.1	0.0	0.0			
Other	12.5	8.7	8.1			
Light Manufacturing	9.9	6.1	5.8			
Construction	2.5	2.5	2.2			
Forest Resources	0.1	0.1	0.1			
Buildings	**28**	**37**	**34**	**23**	**-7**	**21**
Residential	18.2	21.3	18.8			
Commercial and Institutional	9.7	15.9	15.6			
Agriculture	**12**	**12**	**12**	**0**	**3**	**8**
Animal Production	7.3	6.3	6.4			
Crop Production	3.1	3.3	3.7			
On Farm Fuel Use	2.1	2.5	2.5			
Waste	**5**	**6**	**6**	**6**	**0**	**4**
Solid Waste	4.9	5.0	5.0			
Waste Incineration	0.3	0.4	0.4			
Wastewater	0.2	0.3	0.3			
Electricity	**26**	**5**	**5**	**-82**	**-9**	**3**
TOTAL	**179**	**163**	**161**	**-10**	**-1**	**100**

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53.

Note: Methodologies used to produce the National Inventory Report are continuously refined by the IPCC. This includes those used to calculate historical values. Comparisons to historical data presented here are based on the current methodology and some values will not match those presented in our previous reports. In particular, waste sector emissions have been revised in the past year (section 1.2.4).

Transportation – Ontario's largest emissions source

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The reported emissions from the transportation sector in 2016 were 34% higher than 1990 levels. This growth was primarily due to freight vehicles, though on-road passenger vehicles continued to dominate the sector's overall emissions. However, note that the trends shown in Figure 1.22 exclude emissions from international aviation and marine, as the IPCC requires.

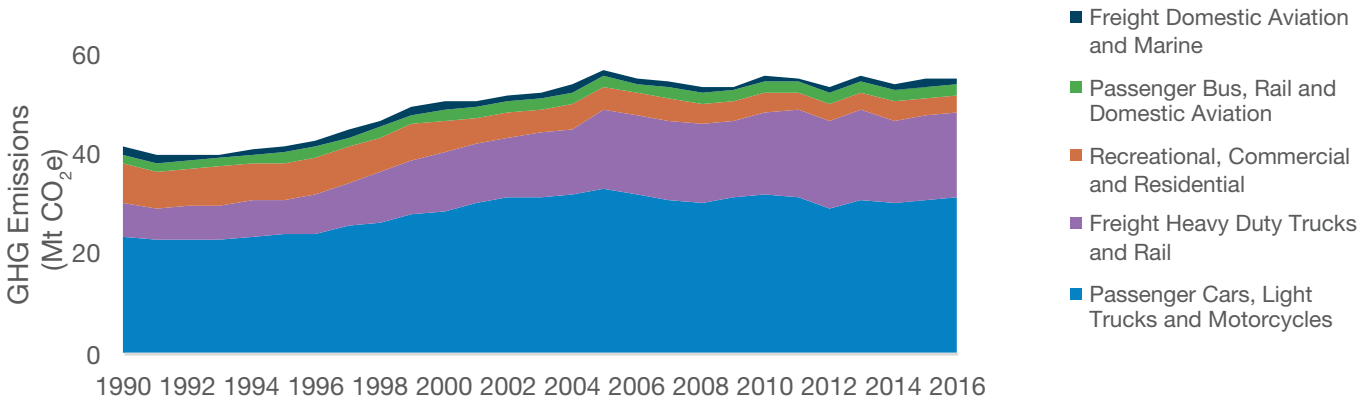


Figure 1.22. Ontario's historical greenhouse gas (GHG) emissions from transportation (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53.

Both freight and passenger on-road travel and emissions continue to grow, as shown in Figures 1.22 and 1.23. Fortunately, the growth in emissions has been moderated by an improvement in fuel efficiencies. The improvement was correlated with increasing fuel prices, as shown in Figure 1.24 for passenger vehicles. Efficiency improvements, however, have been partially undermined by consumer preferences for SUVs and pickup trucks over cars. Additionally, freight truck GHG emissions regulations only began in 2014.

Both freight and on-road passenger emissions continue to grow.

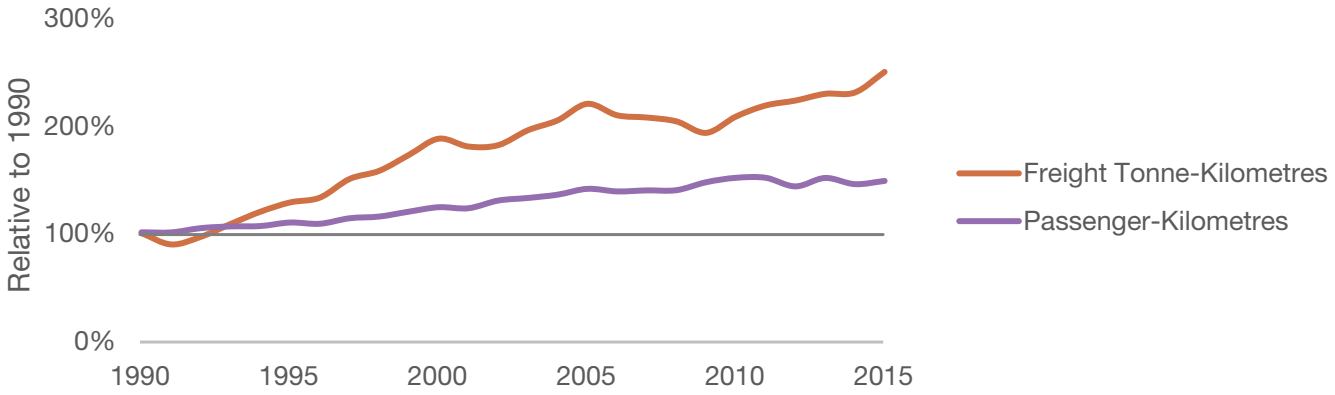


Figure 1.23. Ontario's on-road vehicle activity.

Source: Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Transportation Sector, Ontario, Table 9: Road Transportation Secondary Energy Use and GHG Emissions by Energy Source.

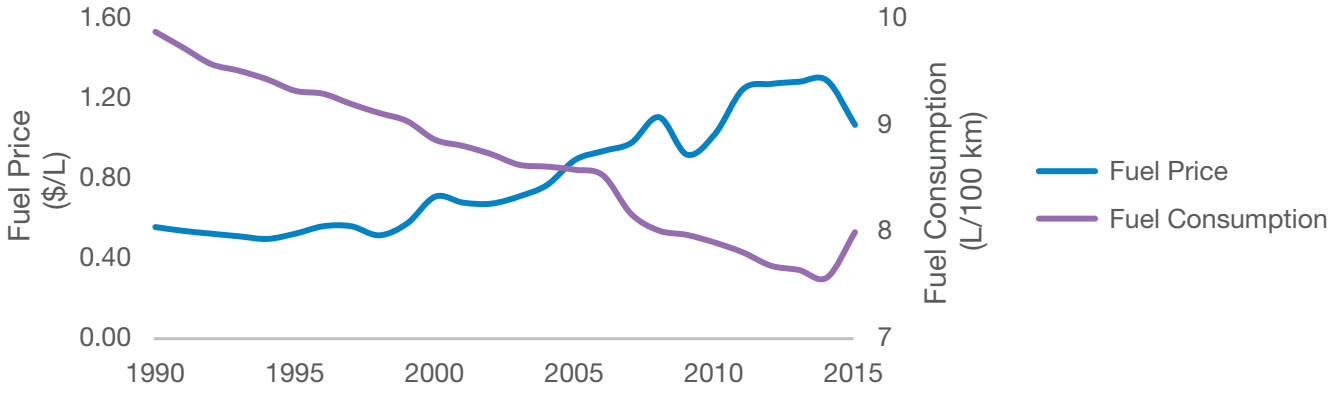


Figure 1.24. Toronto's historical gasoline price and Ontario's historical gasoline car fuel consumption.

Source: Statistics Canada, *Average retail prices for gasoline and fuel oil, by urban centre* (2018), CANSIM Table 326-0009; Natural Resources Canada, Comprehensive Energy Use Database (2018), Transportation Sector, Ontario, Table 21: Car Explanatory Variables.

Nearly all (98%) transportation emissions were from fossil fuel use in vehicles (shown in Figure 1.22). Most of the fuel used is ethanol-blended gasoline, as shown in Figure 1.25. Diesel, aviation fuel, propane and natural gas combustion were also used. (Fuel production emissions are excluded from the transportation sector and instead allocated to industry.) GHG emissions from industrial product use in vehicles, namely air conditioner refrigerant, were minor (2%) and in the form of hydrofluorocarbons.

Nearly all transportation emissions were from fossil fuel use in vehicles.

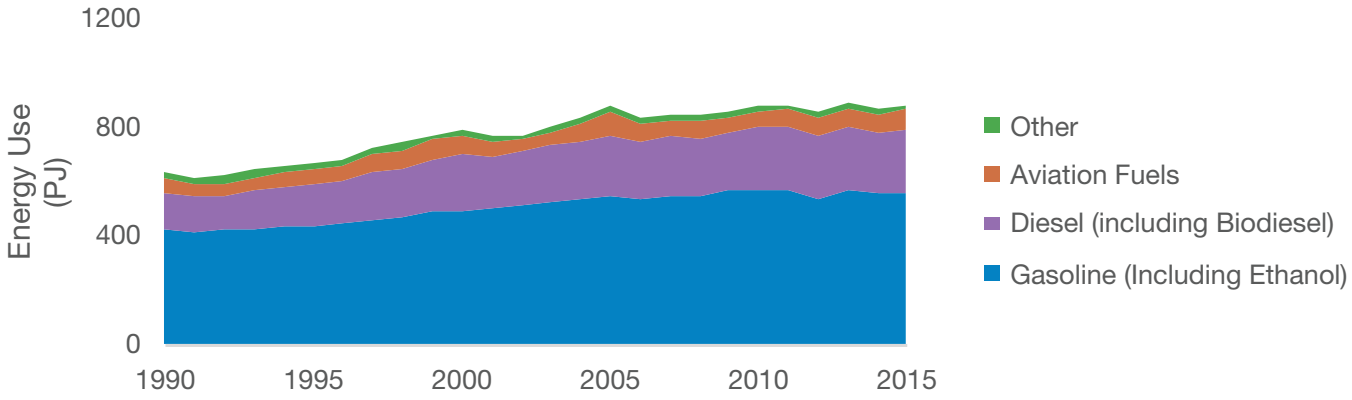


Figure 1.25. Ontario's historical transportation energy use by energy source (in petajoules).

Source: Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Transportation Sector, Ontario, Table 1: Secondary Energy Use by Energy Source.

Industry – transitioning to a low-carbon economy

Ontario's industry sector had 28% lower GHG emissions in 2016 than in 1990. This decrease was due to a reduction in emissions from *heavy industry*, as shown in Figure 1.26. Emissions from oil and gas, light manufacturing, construction and forest resources have remained relatively constant.

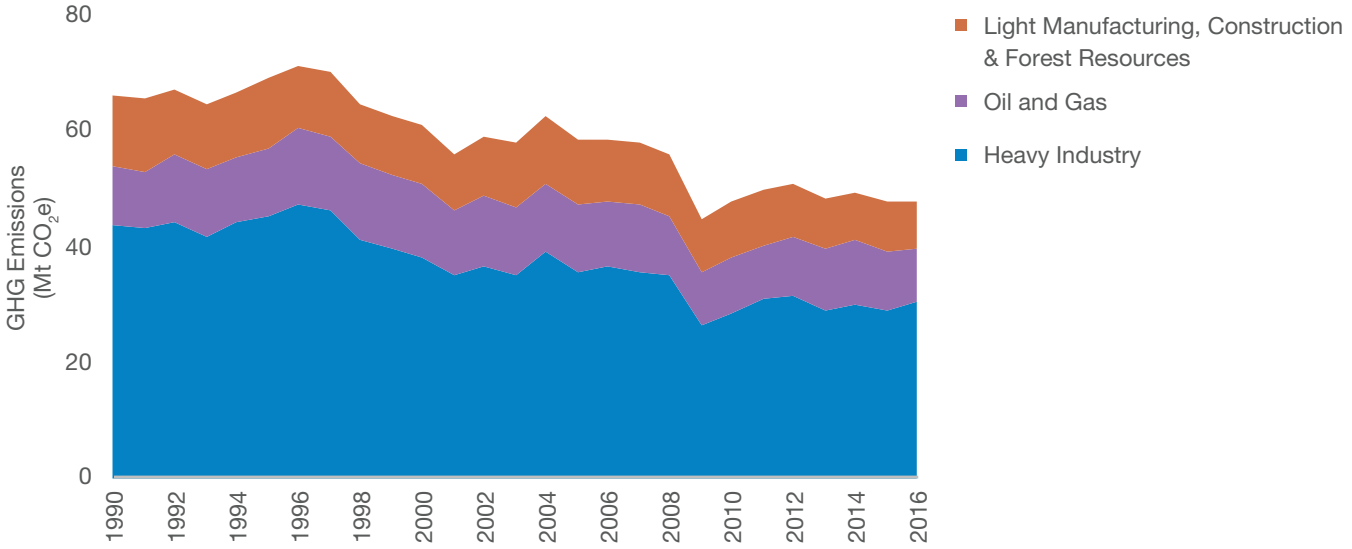


Figure 1.26. Ontario's historical greenhouse gas (GHG) emissions from industry (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53.

A closer examination of *heavy industry* in Figure 1.27 shows the emission reductions occurred primarily in the chemical and fertilizer sector. In particular, a single adipic acid plant with high nitrous oxide emissions, which produced 15% of 1990 industry sector emissions, installed emissions reduction technology in 1997 and shut down in 2009.

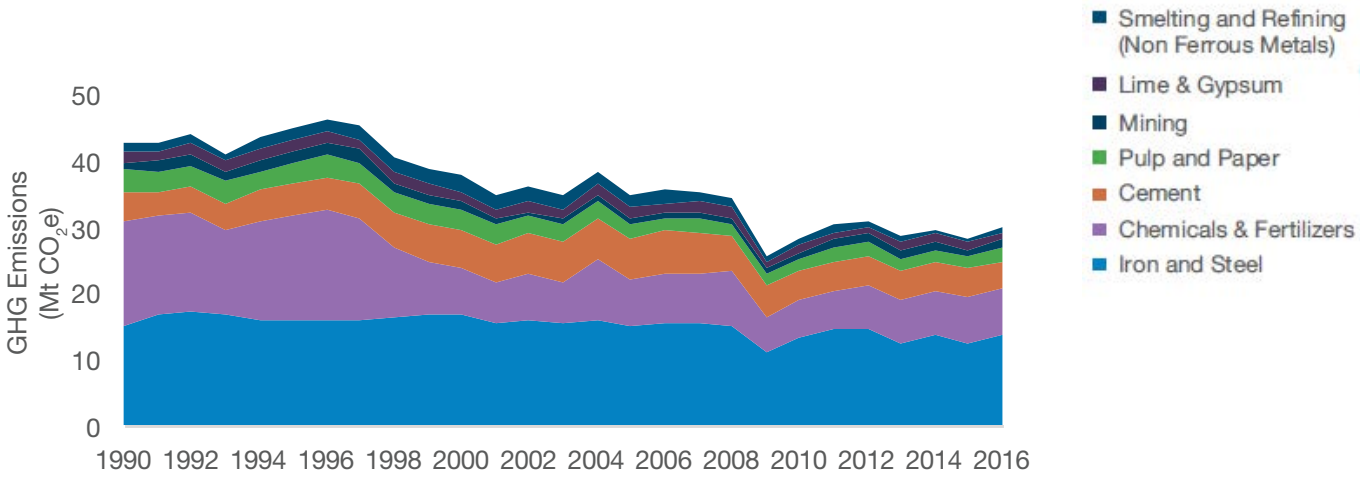


Figure 1.27. Ontario's historical GHG emissions from heavy industry (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53.

Although some emission reductions have been a result of declining industrial production (iron and steel), Figure 1.28 shows economic activity in some industries are similar (chemical and fertilizers) or higher (cement) than they were in 1997, when emissions from industry were at their highest. Gross domestic product of Ontario industrial production has increased 6% since 1997, while GHG emissions have fallen 32%.

Gross domestic product of Ontario industrial production has increased 6% since 1997, while GHG emissions have fallen 32%.

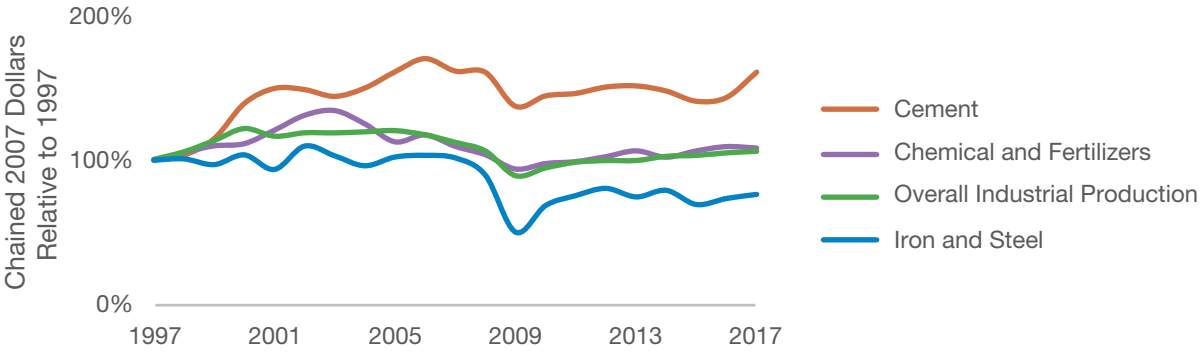


Figure 1.28. Ontario's historical gross domestic product from cement, chemical and fertilizers, overall industrial production, and iron and steel, relative to 1997.

Source: Statistics Canada, *Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS), provinces and territories* (2018), CANSIM Table 379-0030.

GHG emissions attributed to the industry sector were mostly (60%) from energy use (shown in Figure 1.21). These emissions were primarily from combustion, but also include a small quantity of emission leaks from oil and gas infrastructure (leaks, accidents, venting and flaring). The largest source of energy was natural gas used for heat or, to a much lesser extent, for onsite cogenerated electricity (Figure 1.29). (Emissions from electricity generated by offsite sources are allocated to the electricity sector.) Some industries (e.g., oil and gas, pulp and paper) used their own by-products as fuel. Diesel was used for off-road industry (e.g., construction) vehicles.

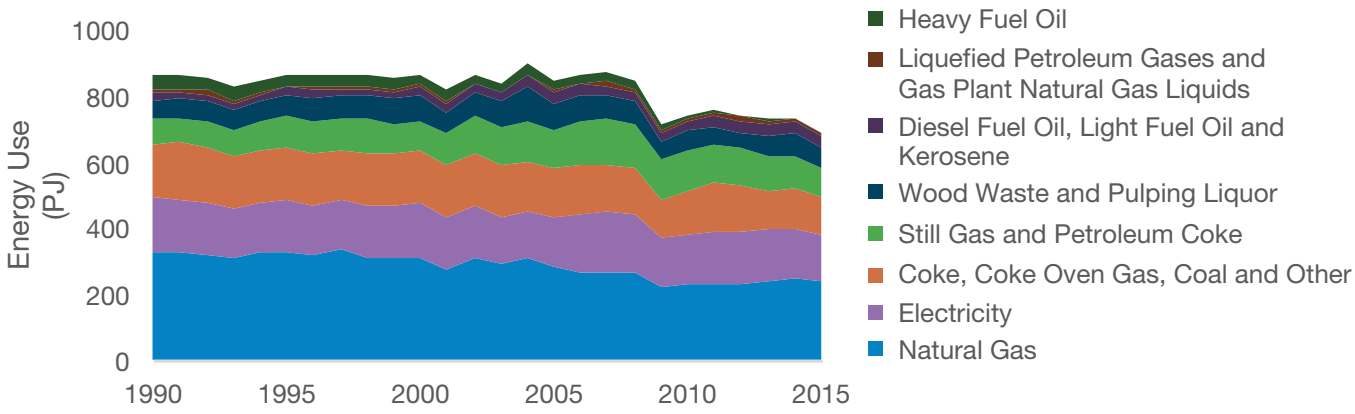


Figure 1.29. Ontario's historical industry energy use by energy source (in petajoules).

Source: Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Industry Sector, Ontario, Table 1: Secondary Energy Use by Energy Source.

The remaining (40%) emissions from the industry sector were from *industrial processes and product use*. This included cement production and was mainly in the form of carbon dioxide, released as a by product when limestone ($CaCO_3$) is converted to lime (CaO).

Buildings – more space for all

Emissions from Ontario buildings increased by 23% in 2016 from 1990. This was primarily due to growth in commercial and institutional building emissions (Figure 1.30).

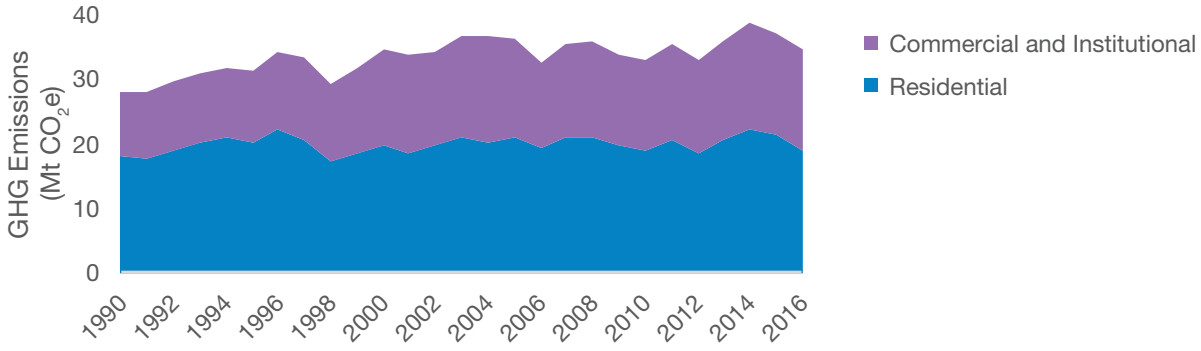


Figure 1.30. Ontario's historical greenhouse gas (GHG) emissions from buildings (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53.

Building sector emissions have increased with population growth (Figure 1.31). Floor space has increased faster than both building emissions and population. This indicates floor space per person has increased, while building emissions per square metre have decreased.

Floor space per person has increased, while building emissions per square metre have decreased.

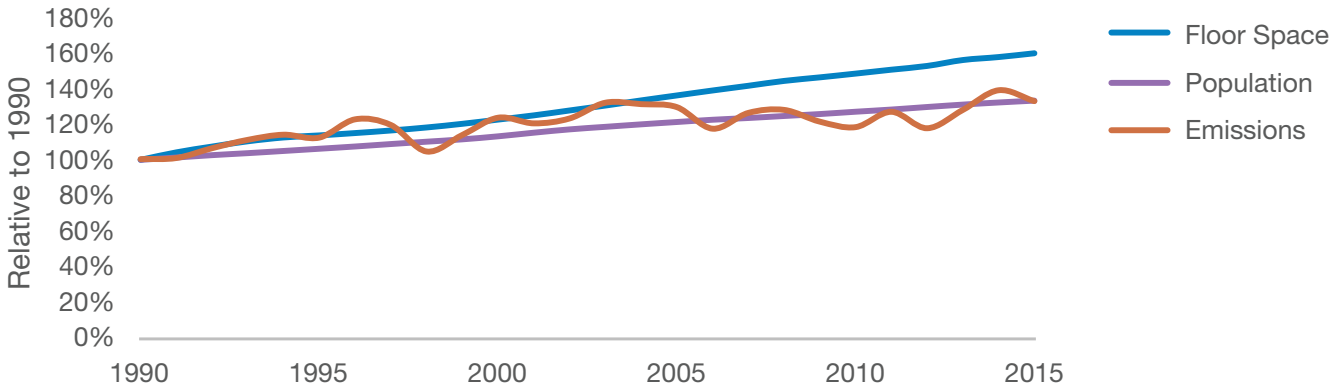


Figure 1.31. Long-term building emissions are increasing with population and floor space.

Source: Natural Resources Canada, Comprehensive Energy Use Database (2018), Commercial/Institutional Sector, Ontario, Table 2: Secondary Energy Use and GHG Emissions by End-Use; Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Residential Sector, Ontario, Table 2: Secondary Energy Use and GHG Emissions by End-Use.

Year-to-year fluctuations in building emissions are closely related to winter temperatures, as measured by heating degree days (measure of how much and how long a building needs to be heated) (Figure 1.32). Warmer winters require less energy use for heating and vice versa.

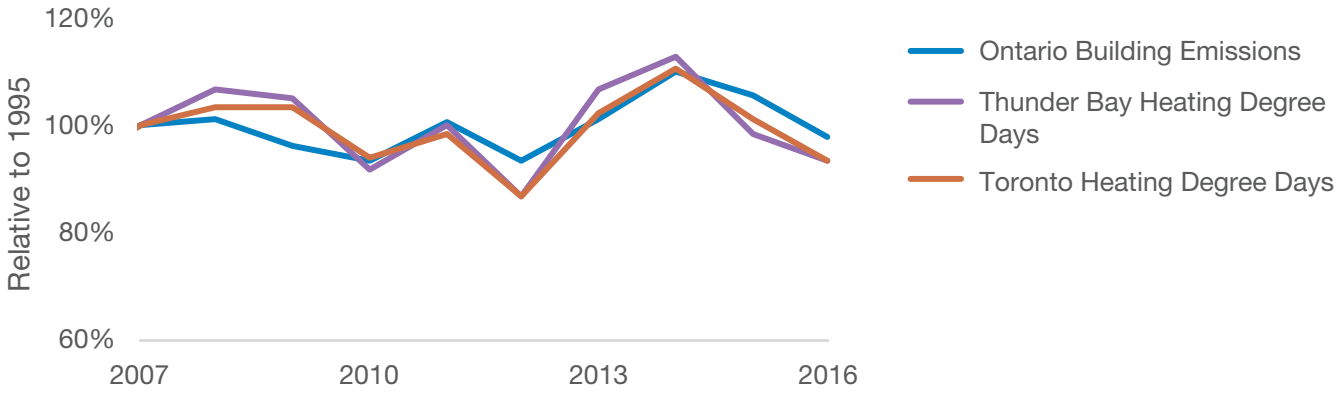


Figure 1.32. Building emissions experience year-to-year fluctuations with winter temperatures.

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53; Canada Weather Stats, (2018), Heating Degree Days (18°C).

Although heating degree days vary widely year-to-year, long-term trend lines show winters are generally getting warmer. This has helped slow the growth in building emissions.

1

Residential energy efficiency improvements have also helped reduce building emissions. Residential building energy intensity (energy use divided by floor space) has fallen much faster than heating degree days primarily because of these efficiency improvements. Unfortunately, commercial and institutional building energy intensity has not improved. Thus, commercial and institutional building emissions have increased, while residential emissions have not (Figure 1.33). Building energy efficiency is further analyzed in the ECO's annual energy conservation reports.

Commercial and institutional building energy intensity has not improved.

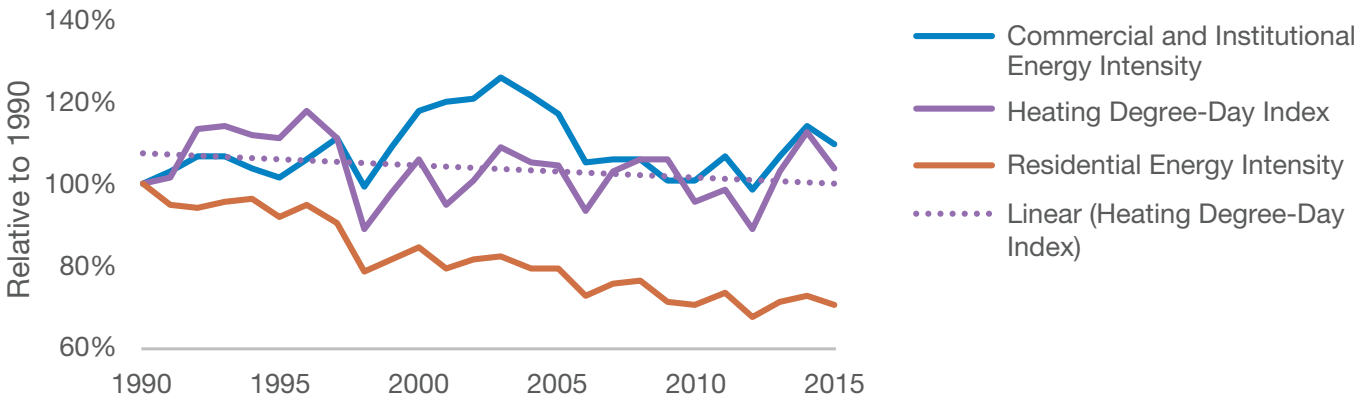


Figure 1.33. Residential buildings are getting more efficient but commercial and institutional building are not.

Source: Natural Resources Canada, Comprehensive Energy Use Database (2018), Commercial/Institutional Sector, Ontario, Table 2: Secondary Energy Use and GHG Emissions by End-Use; Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Residential Sector, Ontario, Table 2: Secondary Energy Use and GHG Emissions by End-Use.

The vast majority (89%) of GHG emissions from the buildings sector were from energy use (shown in Figure 1.21). These were mainly associated with natural gas (Figure 1.34) used for space heating (Figure 1.35). Other uses included water heating, cooking and onsite cogenerated electricity production. (Emissions from electricity generated by offsite sources are allocated to the electricity sector.) Non-energy use emissions included hydrofluorocarbons from refrigerants used for air conditioning and refrigeration.

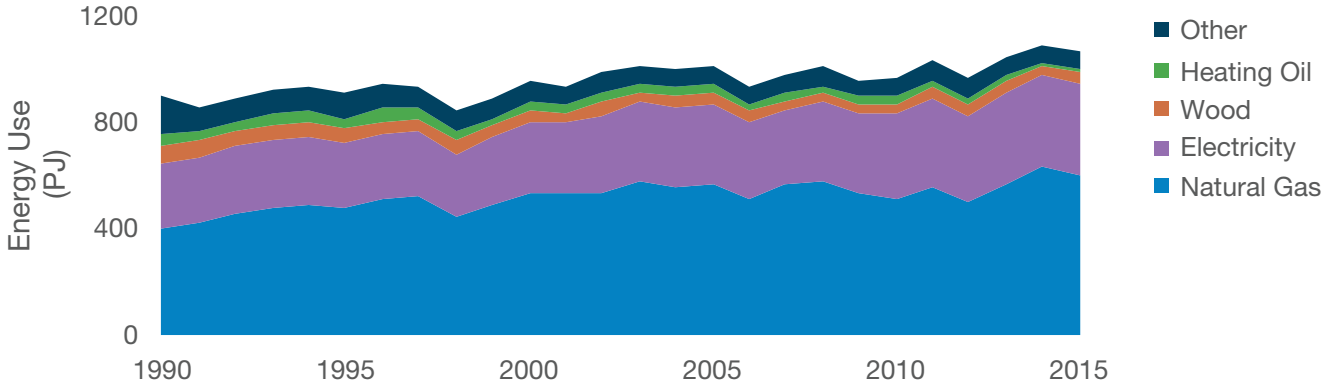


Figure 1.34. Ontario's historical building energy use by energy source (in petajoules).

Source: Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Residential Sector, Ontario, Table 1: Secondary Energy Use by Energy Source; Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Commercial/Institutional Sector, Ontario, Table 1: Secondary Energy Use by Energy Source.

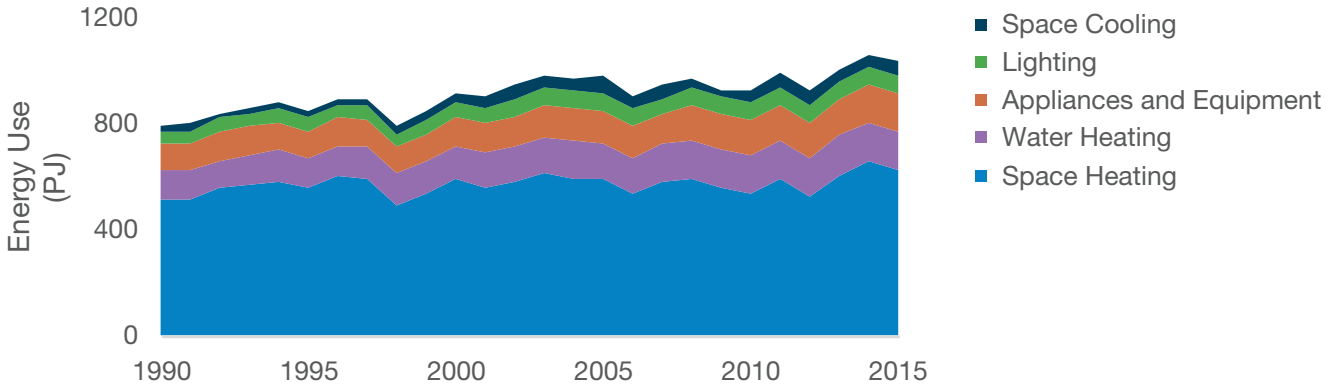


Figure 1.35. Ontario's historical building energy use by end use (in petajoules).

Source: Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Residential Sector, Ontario, Table 2: Secondary Energy Use by End-Use; Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Commercial/Institutional Sector, Ontario, Table 2: Secondary Energy Use by End-Use.

Agriculture – holding steady

Ontario's agriculture sector emissions have remained largely unchanged since 1990. Increasing emissions from crop production and on-farm fuel use have offset a decrease in animal production emissions, as shown in Figure 1.36. Declining cattle populations, as shown in Figure 1.37, have reduced emissions from animal digestion (methane) and manure management (methane and nitrous oxide). Increasing crop production resulted in additional emissions from nitrogen fertilizer use (with associated nitrous oxide).

Ontario's agriculture sector emissions have remained largely unchanged since 1990.

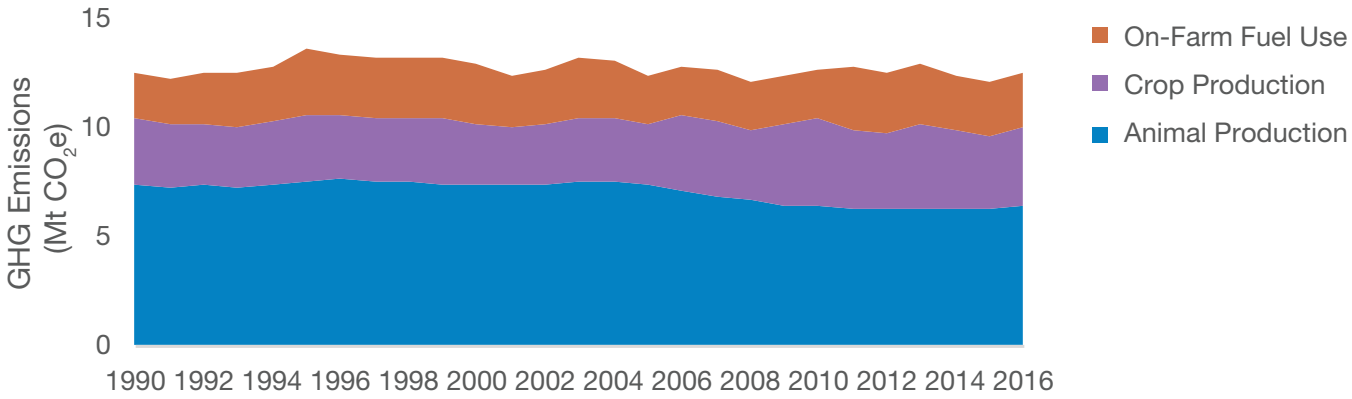


Figure 1.36. Ontario's historical greenhouse gas (GHG) emissions from agriculture (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53.

Increased crop production has also contributed to higher on-farm energy use. Although cropland area has remained relatively constant, Figure 1.37 shows a rapid increase in the area used for higher-value, higher-emission greenhouse vegetable production. Greenhouses, unlike field crops, require heating and typically use natural gas.

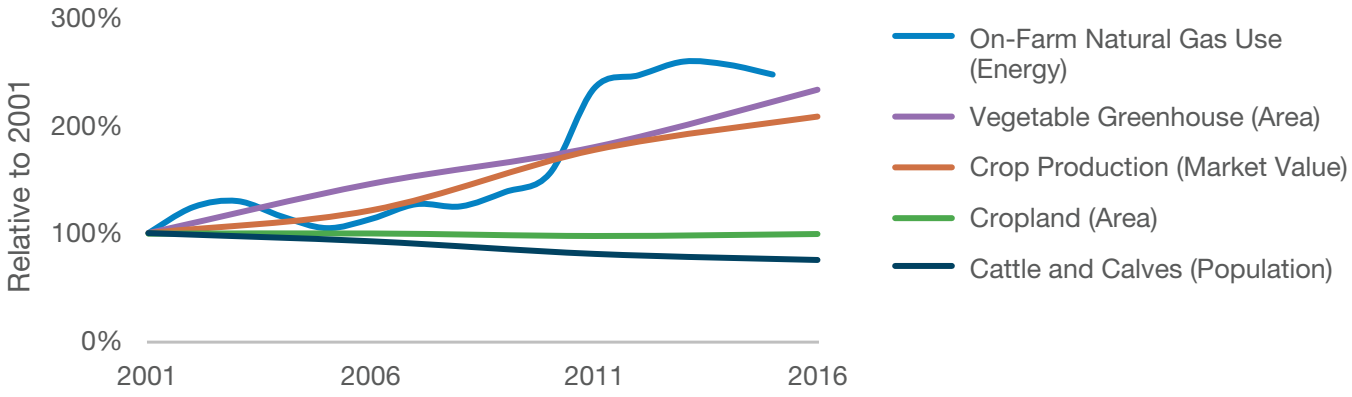


Figure 1.37. Ontario agricultural sector statistics relative to 2001.

Source: Ministry of Agriculture, Food and Rural Affairs, *Statistical Summary of Ontario Agriculture* (2017); Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Agricultural Sector, Ontario, Table 7: Secondary Energy Use and GHG Emissions by End-Use and Energy Source.

Sources of on-farm fuel use other than natural gas have remained relatively constant, as shown in Figure 1.38. These include gasoline and diesel use in on-farm vehicles. (All emissions from electricity use are allocated to the electricity sector, which has low emissions in Ontario.)

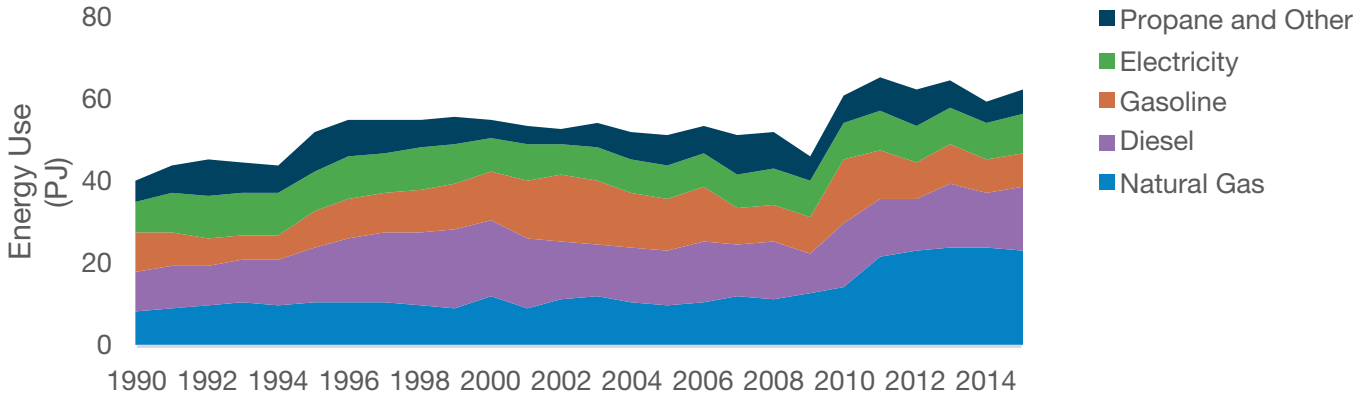


Figure 1.38. Ontario's historical agricultural sector energy use by energy source (in petajoules).

Source: Natural Resources Canada, *Comprehensive Energy Use Database* (2018), Agricultural Sector, Ontario, Table 7: Secondary Energy Use and GHG Emissions by End-Use and Energy Source.

Waste – a big question mark

Ontario's waste sector emissions in 2016 were 6% higher than in 1990. This was due to an increase in estimated solid waste emissions (mostly methane) and, to a lesser extent, wastewater emissions (mostly nitrous oxide), as shown in Figure 1.39. Waste incineration emissions (mostly carbon dioxide) have remained relatively constant. (Waste sector emissions exclude those from refuse trucks, which are allocated to the transportation sector.)

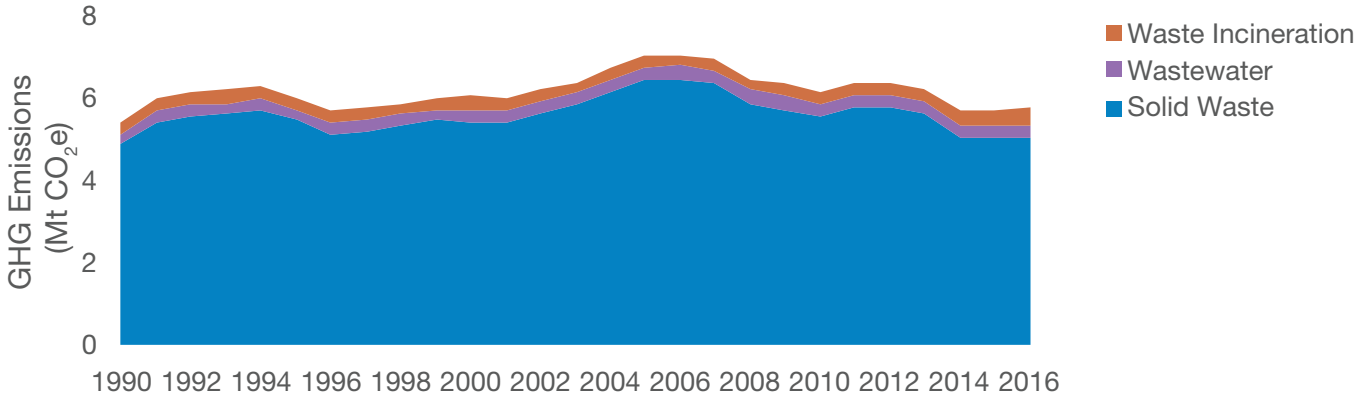


Figure 1.39. Ontario's historical greenhouse gas (GHG) emissions from waste (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53.

Waste sector emission estimates are highly uncertain and may be up to 46% higher or lower than reported. This year, the federal government updated the estimated fraction of waste being converted into methane emissions and revised historical emissions accordingly. Another source of uncertainty is the fraction of methane captured. Large landfills (over 1.5 million cubic metres) are required to capture landfill gas emissions. The methane component can be used to generate electricity, upgraded for injection into natural gas pipelines or flared to produce carbon dioxide and lower the global warming potential of the emissions. However, the effectiveness of these capture systems is uncertain. Fortunately, Ontario has been gradually diverting more solid waste away from disposal, as shown in Figure 1.40.

Waste sector emission estimates are highly uncertain.

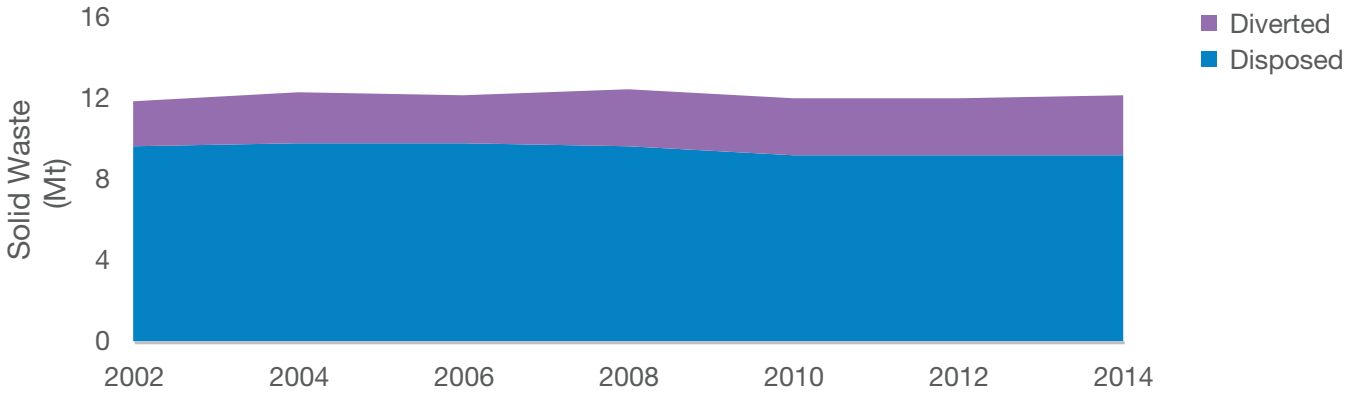


Figure 1.40. Ontario's historical solid waste disposal and diversion (in megatonnes).

Source: Statistics Canada, *Disposal of waste, by source, Canada, provinces and territories* (2016), CANSIM Table 153-0041; Statistics Canada, *Materials diverted, by type, Canada, provinces and territories* (2017), CANSIM Table 153-0043.

Electricity – a big success

Ontario's electricity sector has seen a dramatic 82% decrease in GHG emissions from 1990 levels, as shown in Figure 1.41. As discussed previously, this drop occurred because of the phase out of coal; 2016 was only the second complete year that coal was no longer used to generate electricity in Ontario.

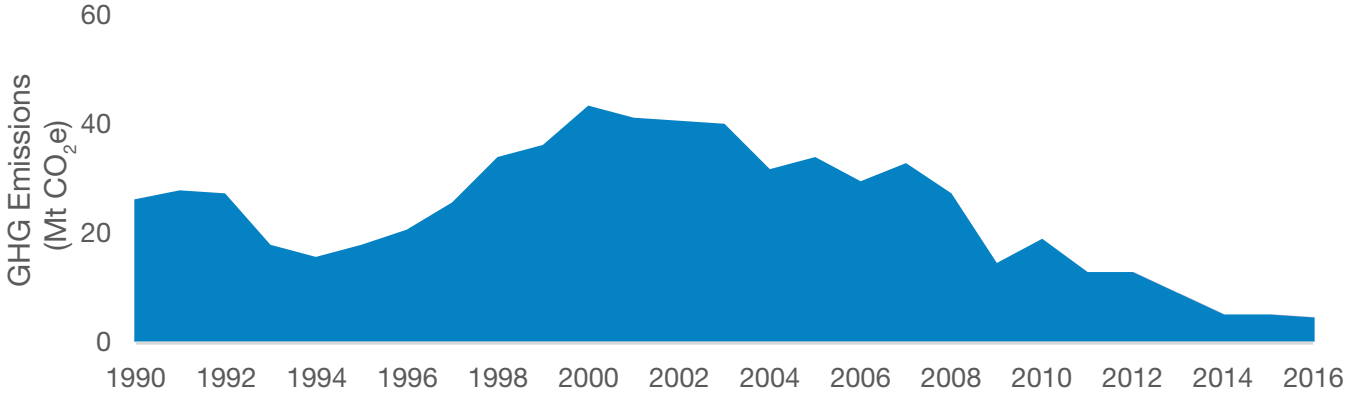


Figure 1.41. Ontario's historical greenhouse gas (GHG) emissions from electricity (in megatonnes of carbon dioxide equivalent, Mt CO_2e).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A12-7, page 53.

Some other sources of electricity have stepped up to replace coal, as shown in Figures 1.42 and 1.44. Although the use of natural gas has increased, it is less GHG-intensive than coal at the point of use and largely limited to supplying electricity when demand is highest. The vast majority of Ontario's grid electricity is generated from sources that do not (directly) release GHG emissions – especially nuclear.

The vast majority of Ontario's grid electricity is generated from sources that do not (directly) release GHG emissions – especially nuclear.

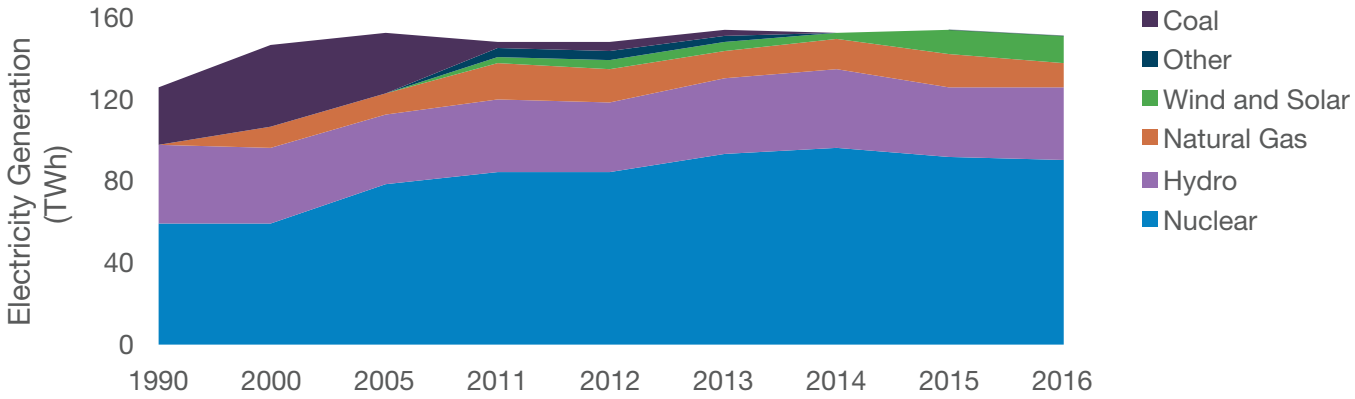


Figure 1.42. Ontario's historical electricity generation by energy source in terawatt hours (TWh).

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A13-7, page 69.

See the ECO's 2018 Energy Conservation Progress Report, for further discussion of the transformation of Ontario's electricity sector, and how conservation and renewables have replaced the electricity formally provided by coal.

1

1.3 How Ontario brought emissions down

Abstract

Ontario is one of Canada's top greenhouse gas (GHG) emitters, second only to energy-rich Alberta. However, Ontario has long recognized the importance of climate change, and was a leader in tackling the issue. The Government of Ontario's actions have significantly reduced the province's GHG emissions, while improving air quality and public health. In 2016, Ontario joined the global movement to put a price on carbon through its *Climate Change Mitigation and Low-carbon Economy Act*, which involved the creation of a cap and trade program for GHG emissions. This law set the stage for growing a cleaner Ontario economy and continuing to reduce the province's contribution to the global carbon pollution that drives climate change. The cap and trade program also raised $2.9 billion to fund emission reductions and brought hundreds of millions of dollars into Ontario.

Contents

1.3.1 First steps towards climate action

As summarized in section 1.1, the danger of climate change has been clear for decades. When Canada, like almost all other countries of the world, signed and ratified the 1992 United Nations Framework Convention on Climate Change, Canadians accepted an international obligation (and one to our children and grandchildren) to:

- *protect the climate system for the benefit of present and future generations of humankind ... take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures…*

- *implement … measures to mitigate climate change[,] … [limit] ... anthropogenic emissions of greenhouse gases and protect[ ] and enhanc[e] ... greenhouse gas sinks and reservoirs… Take climate change considerations into account, to the extent feasible, in … relevant social, economic and environmental policies and actions*

Canadians accepted an international obligation to protect the climate system.

Provinces have the primary constitutional jurisdiction to reduce the emissions that cause climate change. At the time, the largest portion of Canada's emissions came from Ontario, due to our large population and robust industrial base. Yet Ontario took virtually no action to reduce GHG emissions until 2003. Instead, Ontario's GHG emissions rose steeply in the late 1990s when Ontario increased the use of coal to generate electricity.

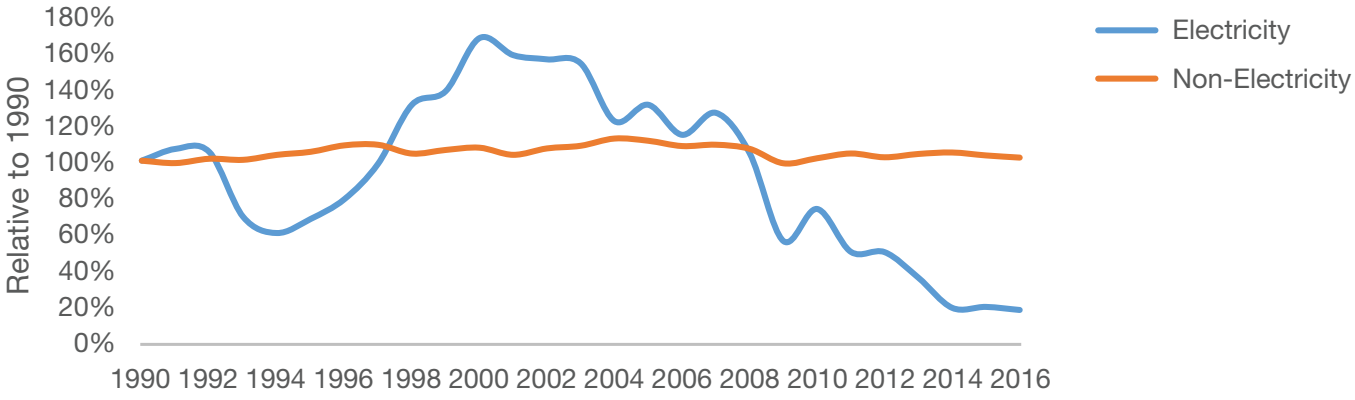


Figure 1.43. Ontario's historical greenhouse gas emissions from electricity use and non-electricity use in other sectors including industry, transportation, buildings, agriculture, and, waste relative to 1990 levels.

Source: Environment and Climate Change Canada, National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada (2018).

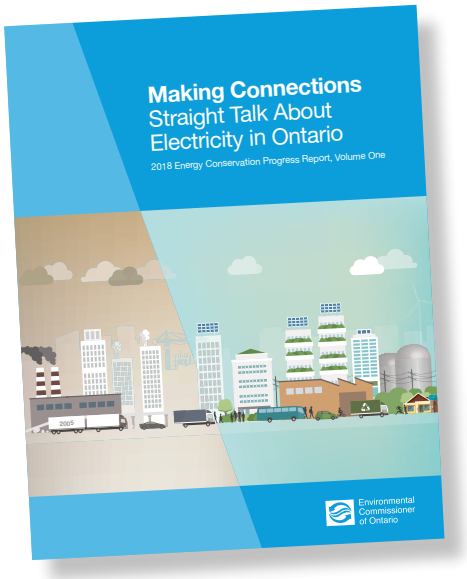
In addition to creating climate pollution, this action helped create a yellow smear of smog across the Greater Toronto Area and down into eastern Ontario.

1

Smog over the City of Hamilton on July 25, 2000.

Photo credit: Hamilton Spectator, 2016.

The dirty air made life more difficult for Ontario's hundreds of thousands of asthmatics and generated protests from the public health community. Air quality was so bad that, in 1999, the government began Drive Clean, a vehicle emissions-testing program. This program aimed to reduce smog-causing emissions from light-duty vehicles (i.e., passenger cars) and heavy-duty vehicles (i.e., buses and trucks) older than seven years. Vehicles whose emissions were above provincial limits for the age of the vehicle were identified for repair, which in some instances may have helped to improve fuel efficiency (i.e., reduce fuel use) and reduce GHG emissions. Nevertheless, coal-fired emissions continued to grow, along with public concern about dirty air.



All political parties in the Legislature supported phasing out coal-fired electricity generation. Ontario's phase out of coal is the single largest GHG-reduction initiative in North America.

By the election of 2003, all three political parties in the Ontario Legislature supported phasing out coal-fired electricity generation. Ontario's phase out of coal between 2005 and 2014 is the single largest GHG-reduction initiative in North America to date. And it made a considerable contribution to improving air quality, including the near elimination of smog days (see the ECO's 2018 Energy Conservation Progress Report, Making Connections: Straight Talk About Electricity in Ontario, Q12).

Ontario's coal ban also helped to inspire action in other jurisdictions.

Ontario's coal ban also helped to inspire action in other jurisdictions. In 2017, all partners in the Powering Past Coal Alliance committed to phasing out all coal-fired power stations that do not have carbon capture and storage. This alliance includes 28 countries, 4 provinces (including Ontario), 4 American states, the City of Vancouver, and over 25 businesses and other organizations.

The Ontario government began to take a more formal and comprehensive approach to climate action after the 2006 U.K. Stern Review, The Economics of Climate Change, documented the huge economic costs of

The Stern Review documented the huge economic costs of failing to act on climate change, and the economic benefits of a low-carbon economy.

failing to act on climate change, and the economic benefits of a low-carbon economy. Ontario joined the Western Climate Initiative and began negotiations to build a regional cap and trade system. The Go Green Climate Change Action Plan (2007) established Ontario's first GHG emission reduction targets.

In 2007, the government established GHG emissions reduction targets for 2014, 2020 and 2050; in 2015 the government added an interim target for 2030. The 2020, 2030 and 2050 targets were later enshrined in law in section 6 of the *Climate Change Mitigation and Low-carbon Economy Act, 2016*, which, at the time of writing, faced repeal.

Ontario's targets were to reduce provincial GHG emissions relative to 1990 levels:

- 6% by 2014 (11 megatonne (Mt) reduction to approximately 168 Mt CO_2e)
- 15% by 2020 (27 Mt reduction to approximately 152 Mt)
- 37% by 2030 (66 Mt reduction to approximately 113 Mt), and
- 80% by 2050 (143 Mt reduction to approximately 36 Mt).

Another key step taken by the province was to provide financial support for energy conservation and for renewable energy generation, including the creation of the first Feed-in Tariff program in Canada. This program was launched under the *Green Energy and Green Economy Act, 2009*. These programs helped homeowners and businesses in urban and rural communities earn money or reduce energy bills while investing in energy efficiency and renewable energy. This program helped reduce Ontario's use of fossil fuels for electricity generation (see the ECO's 2018 Energy Conservation Progress Report, Making Connections: Straight Talk About Electricity in Ontario for more details). Other key initiatives designed to reduce emissions include the province's *Places to Grow Act, 2005* that promoted greener, more efficient communities in Ontario, the province's Integrated Power System Plan (2007), the requirement for ethanol blending of gasoline (2007), and investments in public transit (The Big Move, 2008).

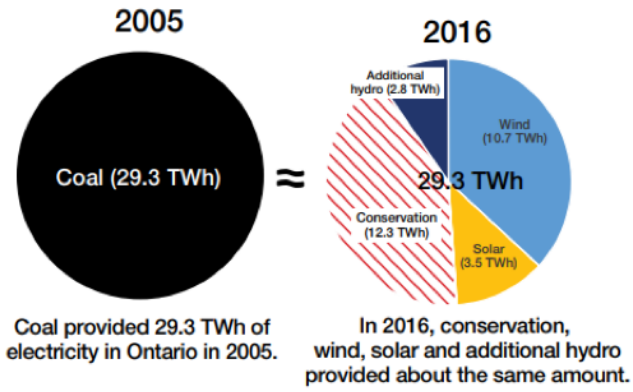
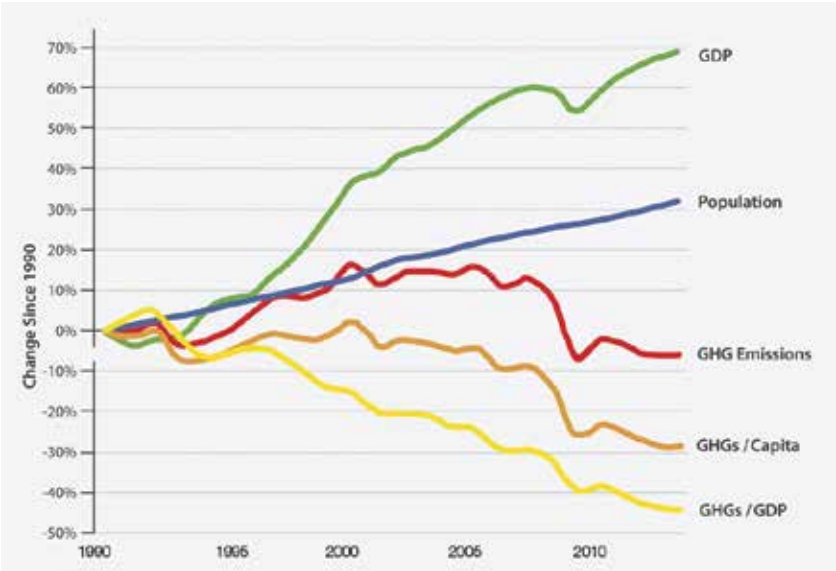


Figure 1.44. How conservation and renewable energy replaced coal as a source of electricity in Ontario between 2005 and 2016.

Source: Environmental Commissioner of Ontario's 2018 Energy Conservation Progress Report.

Ontario successfully achieved its first GHG emissions reduction target (2014); by 2016, emissions were 161 Mt CO_2e, 10% below those in 1990. This is an impressive accomplishment. In fact, GHG emissions dropped to their lowest level on record while the province's population and gross domestic product (GDP) continued to grow. Emissions of dangerous air pollutants also dropped. GHG emissions in 2016 were 23% below their historical peak, which occurred in 2000, and 3% below the emissions in 2009 during depths of the economic recession.



GHG emissions dropped to their lowest level on record while the population and gross domestic product grew.

Figure 1.45. Ontario's greenhouse gas (GHG) emissions relative to gross domestic product (GDP) and population since 1990.

Source: Statistics Canada, Gross domestic product, expenditure-based, provincial and territorial (2016), CANSIM Table 384-0038; Statistics Canada, Population by year, by province and territory (2016), CANSIM Table 051-0001.

However, closing the coal plants and investing in nuclear and renewable energy also contributed to increased electricity costs in Ontario, which became a major flashpoint in the 2018 provincial election.

1.3.2 The Paris Agreement and the Pan-Canadian Framework

Canada was an important player in negotiating the historic Paris Agreement under the United Nations Framework Convention on Climate Change. All countries of the world, for the first time, agreed to work together to reduce their GHG pollution.

The Paris Agreement was adopted on December 12, 2015, and came into force November 4, 2016. It is a landmark agreement, to keep the global average temperature increase well below 2°C compared to pre-industrial level, and ideally below 1.5°C.

Although the world agreed to the United Nations Framework Convention on Climate Change in 1992, it took an additional 23 years of compromise, negotiation, and hard work to reach the Paris Agreement, the world's first universal, legally binding climate agreement. Finally, for the first time, everyone was in. Under the agreement, 174 countries have produced and enacted national climate plans, bringing with them potential co-benefits that include:

- improved air quality and an associated reduction in deaths and illnesses from air pollution
- the use of cleaner and more efficient technologies to produce the goods and services that people consume, and
- a net increase in employment.

Canada made an initial national commitment to the Paris Agreement to achieve a 30% reduction in national GHG emissions by 2030. In 2016, the Canadian government and 11 provinces and territories (including Ontario) negotiated the Pan-Canadian Framework on Clean Growth and Climate Change. The framework lays out steps these governments agreed to take to produce

the reductions needed to achieve Canada's initial commitment. The framework also provides provinces and territories with tools to help them participate in the global low-carbon economy that is well underway.

The framework marked the first time that the federal, provincial and territorial governments, and all major sectors of the Canadian economy, came together on a mutually agreed path of climate action. The framework received widespread support from many businesses, industries and other groups, such as the Canadian Public Health Association, General Electric Canada, the Ontario Federation of Labour, the Assembly of First Nations, the Business Council of Canada, the United Steelworkers, Royal Bank of Canada, Suncor and Shell Canada. Canadians also expressed their support for action; according to a Canada 2020 poll, 84% of Canadians believe that Canada has an obligation to demonstrate international leadership in reducing GHG emissions.

84% of Canadians believe that Canada has an obligation to demonstrate international leadership in reducing GHG emissions.

Putting a price on carbon

As a key element of the Pan-Canadian Framework, the participants agreed to put a price on GHG pollution, at the federal level if not done by individual provinces. Numerous studies show that this polluter-pay approach is the cheapest and most efficient way to reduce GHG emissions.

Globally, there are 51 carbon-pricing initiatives in place or scheduled at regional, national and subnational scales. The initiatives already in place have helped governments raise approximately US$33 billion in 2017 and cover 20% of annual global GHG emissions. Other

Polluter pay is the cheapest and most efficient way to reduce GHG emissions.

well documented benefits include the US$5.7 billion in public health improvements experienced in just three years by nine northeastern U.S. states. These states are part of the Regional Greenhouse Gas Initiative (RGGI). Launched in 2009, RGGI is North America's first cap and trade program to reduce carbon pollution from power plants. Revenues generated from the RGGI are invested into energy efficiency and other clean energy measures.

The U.S. had already demonstrated effectiveness of putting a price on pollution when it adopted its successful cap and trade system for sulphur dioxides, to reduce acid rain.

> *The program, while not without flaws, is viewed as a success by almost all measures. Certainly it demonstrated that broad-based cap-and-trade systems can be used to achieve significant emissions reductions, that firms can navigate and regulators can enforce the compliance requirements of such systems, and that giving the private sector the flexibility to pursue a range of abatement options can simultaneously protect the environment, stimulate innovation and diffusion, and reduce aggregate costs.*
>
> The SO_2 Allowance Trading System and the Clean Air Act Amendments of 1990: Reflections on Twenty Years of Policy Innovation (G. Chan, R. Stavins, R. Stowe, and R. Sweeney).

1.3.3 Ontario adopts climate law and cap and trade

In 2016, Ontario joined the global movement of putting a price on carbon, by adopting the *Climate Change Mitigation and Low-carbon Economy Act* (the *Climate Act*). The *Climate Act* was adopted after extensive stakeholder and full public consultation under the *Environmental Bill of Rights*. This act:

- established in law Ontario's GHG emission reduction targets
- launched a cap and trade program to minimize the cost of GHG reductions, and
- directed all cap and trade revenues to fund initiatives that reduce or support the reduction of GHG emissions.

The Act gave climate polluters a financial incentive to reduce their emissions.

The targets set by Ontario were ambitious but achievable; the targets aligned with the actions of other provinces and U.S. states and were in line with global objectives. The program was broad in scope and was designed to benefit both rural and urban Ontarians.

The *Climate Act* gave climate polluters a financial incentive to reduce their GHG emissions. Large emitters, who are the most knowledgeable about their own operations, were free to choose the most cost-effective way to meet their obligations, whether by:

- reducing emissions through process changes or investing in low-carbon technologies, which often improved efficiency
- acquiring or purchasing carbon allowances, or
- purchasing carbon offsets.

The associated costs were either absorbed by the GHG emitters, repaid through efficiency improvements or passed on to customers.

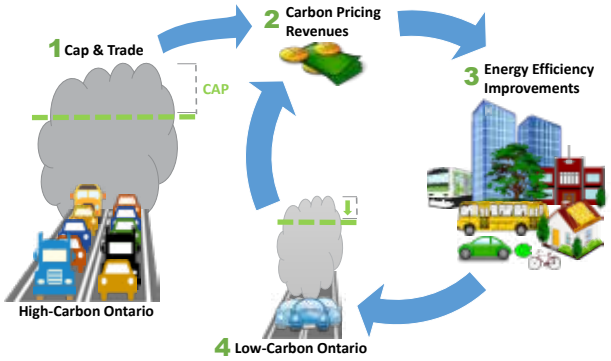
The government also released a Climate Change Action Plan (2016) listing initiatives to be funded by the cap and trade revenues. These initiatives were focused on helping people, businesses, and municipalities improve energy efficiency and transition to cleaner energy sources. The ECO explained the act and the plan in our 2016 Greenhouse Gas Progress report, Facing Climate Change.

Roll-out of Ontario's cap and trade program and the initiatives that it funded

Ontario's cap and trade program came into effect in January 2017. Four auctions were held in 2017 to allow mandatory participants (Large Final Emitters, businesses that distribute an amount of natural gas that if consumed would emit at least 25,000 tonnes of CO_2e a year, fuel suppliers that sell more than 200 litres of fuel per year, and electricity importers) to purchase allowances to fulfill their emission reduction obligations. By the end of 2017, Ontario's cap and trade program generated over $1.9 billion in revenue.

Ontario's cap and trade program generated over $2.9 billion in revenue.

As discussed in Appendix B, the government distributed the revenue to over 50 initiatives through the Greenhouse Gas Reduction Account (GGRA). These included GreenON, the GO Regional Express Rail Program, the Electric Vehicle Incentive Program, the Social Housing Apartment Improvement Program, and a number of energy retrofit initiatives for schools, homes, universities, colleges and hospitals. A key goal of these initiatives was to further reduce emissions from two of Ontario's biggest emitting sectors – transportation and buildings, including household energy use.



The government released $1.9 billion in cap and trade revenues, which provided partial funding to clean economy projects undertaken by more than 500 recipients across Ontario, including:

- 120+ municipalities
- 120+ Ontario-based businesses
- 98 hospitals
- 72 school boards and more than 600 schools
- 50+ social housing providers, and
- 48 colleges and universities.

Based on this committed provincial government funding, many organizations invested in staff, facilities, partnerships, plans and low-carbon technologies to reduce, or support the reduction of, GHG emissions. Ontarians also benefited from incentives to purchase low-emissions vehicles, energy efficient windows, and other products.

Initiatives to reduce GHG emissions would also have contributed to cleaner air, and to reduce road congestion.

Air pollutants generated from burning fossil fuels directly harm human health. Many of the GGRA-funded initiatives to reduce GHG emissions would also have contributed to cleaner air, and to reduce road congestion. Some of these initiatives included:

- $324 million for electrification of GO Regional Express Rail
- $104 million for municipal cycling infrastructure
- $136 million for rebates on electric and hydrogen vehicles (which enabled Ontario to become one of the fastest growing markets for these vehicles, with annual growth of 100% or more)
- $23 million for electric vehicle charging stations in workplaces and public locations, and
- $23 million for electric municipal buses in Toronto, Brampton and York Region. Its key objective was to prove viability and to develop common standards, which would allow North American industry to better compete with international companies.

Cap and trade funds helped to leverage business investment in Ontario.

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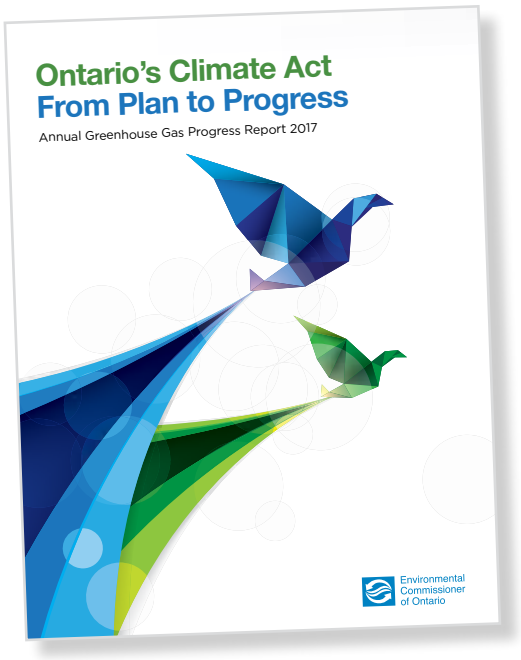
Cap and trade funds helped to leverage business investment in Ontario. For example, every contract awarded under the TargetGHG Industrial Demonstration program (administered by the Ontario Centres of Excellence) required companies to supply at least half of project costs, leveraging almost $200 million in additional investment capital into Ontario.

The government also began working on a carbon offset program to encourage the development of emission reduction projects in Ontario's uncapped sectors, including the agriculture, waste and forestry sectors. Any emission reductions resulting from the offset projects would have been sold as credits in the cap and trade market. Offset projects would have had many co-benefits, including the creation of new economic opportunities for rural and remote communities through investment from capped emitters (see the ECO's 2017 Greenhouse Gas Progress Report, Chapter 4 for more details).

Ontario links its cap and trade program with carbon market leaders

In 2018, Ontario linked its cap and trade program with those of Quebec and California, becoming part of the largest carbon market in North America. Since its start in 2012, California's cap and trade system raised a total of US$13.5 billion, with US$7.9 billion allocated to California's Greenhouse Gas Reduction Fund and the remaining US$5.6 billion going to utilities. Quebec's system has raised $2.3 billion since 2013 for the province's Green Fund that supports Quebec companies, municipalities, institutions and citizens in their adoption of low-carbon practices.

Joining the Ontario carbon pricing market with those in California and Quebec allowed Ontario to build stronger relationships and share expertise with these two major



trading partners on a variety of environmental and energy issues. California is a world leader on many of these issues, and Ontario was able to draw from its deep regulatory and subject matter expertise.

By May 2018, Ontario had participated in two joint auctions, and its participation in these brought Ontario's total revenues to about $2.9 billion. All of this money was earmarked for emissions reductions initiatives that would benefit the people of Ontario. The ECO evaluated how well the government was spending this revenue in our 2017 Greenhouse Gas Progress Report, From Plan to Progress. Updates to this evaluation are provided in Appendix B. In brief, there was room for improvement, but many badly needed projects with good potential were being funded, and innovation and initiative was being stimulated across Ontario.

Many badly needed projects with good potential were being funded, and innovation and initiative was being stimulated across Ontario.

Cap and trade and the programs it was funding were having a profound effect.

Ontario benefits from climate leadership

The polluter-pay carbon pricing system gave Ontario emitters, for the first time, a financial incentive to both understand and reduce their GHG pollution. Carbon prices were low, and it was inevitably going to take time for a $2 billion/year carbon pricing system to turn around Ontario's $800 billion/year economy. That is why both the Auditor General of Ontario and the ECO highlighted that the carbon price alone would not be sufficient to achieve Ontario's 2020 emission reduction target.

However, no one should underestimate the effect of having a price on GHG pollution. When combined with strategic reinvestment of the revenues, carbon pricing systems can have a significant impact on GHG emissions. The RGGI system is an example of the powerful effect of this combination when sustained over time, even when carbon prices are very low. From the ECO's meetings with stakeholders across Ontario, plus our review of government documents, it is clear that cap and trade and the programs it was funding were having a profound effect. Institutions and organizations were, often for the first time, getting serious about understanding and reducing their GHG pollution, and were finding ways to become more innovative and efficient. It was going to take time to see results, but an impressive groundswell was underway (see examples below).

The combination of Ontario's price on carbon pollution, plus access to grants funded by cap and trade revenue, created the business case for industry in Ontario to make many investments. For example:

Goldcorp
Goldcorp invested in the world's first all-electric underground gold mine in Chapleau, Ontario. The Borden Mine is expected to have lower operational costs and a better underground environment for workers, and could be a model for other mines elsewhere in the world.

General Motors
General Motors (GM) made an important upgrade to its St. Catharines Propulsion Plant that allows waste landfill gas to be captured and used to power the plant. Next door to the Propulsion Plant is a landfill whose waste releases methane, a potent GHG and air pollutant which is also a valuable energy source. Methane from the landfill used to be simply destroyed. Now it will be piped instead to the GM plant, where it will be burned to produce 6.4 MW of electricity and 8.2 MW of heat. This will reduce the plant's GHG emissions by about 80%, while significantly reducing GM's electricity and energy bills. It will also reduce GHG emissions from the landfill.

The combined environmental and economic benefits will make the GM plant one of the most efficient in North America, increasing its competitiveness and helping to keep good jobs in St. Catharines.

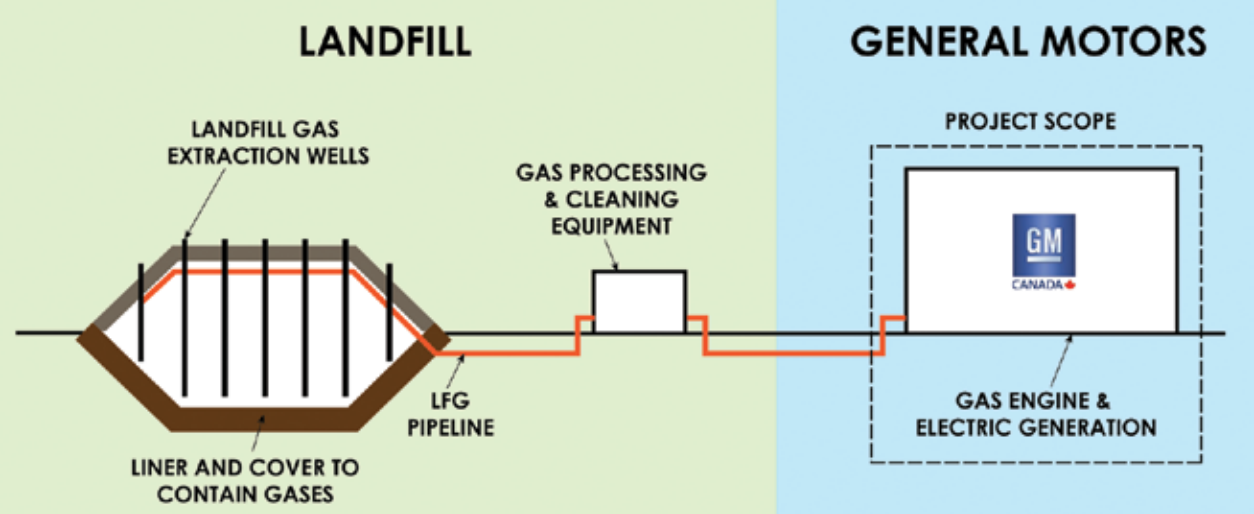


Figure 1.46. Schematic of GM's project to use renewable landfill gas to power its St. Catharines Propulsion Plant.

Source: GM Canada, 2017.

Other industries were also beginning to respond to the price put on carbon by Ontario's cap and trade program by innovating and collaborating to reduce waste, decrease carbon pollution, and create more sustainable products, all while investing and creating jobs of the future, here in Ontario.

- Markham-based Pond Technologies began developing a carbon-eating algae to capture industrial emissions and turning the algae growth into biofuels and fertilizers for revenue. This technology was being tested by St. Marys Cement Inc. located in St. Marys, Ontario.
- Stelco and Walker Environmental were starting to use old waste railway ties as a substitute for coal at their Hamilton plant.

Ontario's climate leadership gave it visibility and credibility.

Internationally, Ontario had achieved a valuable reputation as a global leader in fighting climate change. Ontario's climate leadership gave it visibility and credibility in international forums attended by major investors from around the world who are looking for clean economy investment opportunities. Generating investment takes time, but the successful roll out of cap and trade was attracting millions of dollars of investment into, and interest in working with, Ontario.

Ontario's climate leadership also laid an important foundation for Ontario's clean technology sector. In 2017, this sector included 5,000 companies with 130,000 employees, generating about $19.8 billion in revenue each year (see section 1.5.2 of this report for more information on Ontario's clean technology sector). The Ontario Environmental Industries Association has been a strong voice for climate action in Ontario and urges that "succeeding in the fight against climate change is a choice we must make. We must, as a province, choose to succeed."

In all, industries and businesses in Ontario demonstrated that they were ready and able to comply with the cap and trade program. And contrary to fears that the carbon market would drain hundreds of millions of dollars out of the province, Ontario received about $250 million from out-of-Ontario entities during the first six months of 2018. However, the May 2018 joint auction would turn out to be the last one that Ontario would participate in.

Where are we now?

1

No climate policy, no emissions targets, no money for solutions. Climate polluters pollute for free. No consequences for non-compliance.

1.4 2018: A wrenching halt

Abstract

In June 2018, Ontario's climate progress came to an abrupt halt. Without public consultation, and without giving notice as called for by the linking agreement Ontario had with Quebec and California, the new Ontario government cancelled the cap and trade program, introduced legislation to repeal the *Climate Change Mitigation and Low-carbon Economy Act, 2016* and cancelled contracts and funding commitments for renewable energy and greenhouse gas (GHG) emission reduction projects across Ontario.

Bill 4, the proposed *Cap and Trade Cancellation Act, 2018*, contains nothing of substance, except to dismantle the previous framework. It would leave Ontario with no statutory emission targets, no pathway to achieve targets, weak reporting, no carbon price, and no stream of revenue to invest in solutions. Many parties who, in good faith, invested time, money, expertise and credibility in Ontario emission reduction projects have been left with damaged relationships and uncompensated losses. This affects Ontario's economy as well as its environment and climate progress.

Contents

"Climate change is not a conventional environmental issue...It implicates virtually every aspect of a state's economy, so it makes countries nervous about growth and development. This is an economic issue every bit as it is an environmental one."

Todd Stern — Former United States Special Envoy for Climate Change

1.4.1 *Repealing the* Climate Change Mitigation and Low-carbon Economy Act, 2016

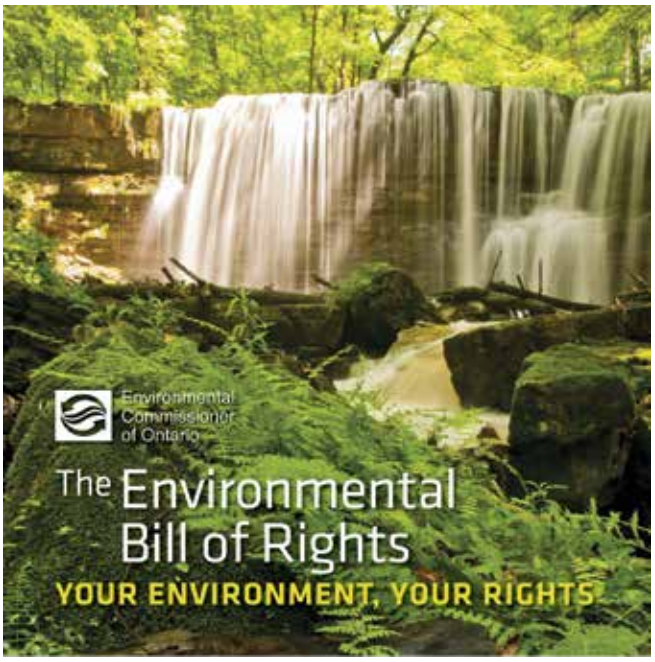
On June 15, 2018, the Premier designate announced that the first act of the new government would be to cancel cap and trade. He stated that Ontario would give immediate notice of withdrawal from the cap and trade market link with Quebec and California, as well as from the Western Climate Initiative. The linkage agreement between the three jurisdictions permits any party to withdraw from the linked program, but the agreement states that a:

> *Party that intends to withdraw from this Agreement shall endeavour to give 12 months' notice … to the other Parties [and] shall endeavour to match the effective date of withdrawal with the end of a compliance period.*

Ontario did not comply with either of these provisions (the compliance period ends in 2020). Instead, government officials were directed to immediately take steps to withdraw Ontario from future auctions for cap and trade allowances. In response, Quebec and California blocked cap and trade participants in their jurisdictions from transferring allowances to or from the accounts of Ontario participants.

On July 3, 2018, the government officially cancelled Ontario's cap and trade program by filing O. Reg. 386/18 (Prohibition Against the Purchase, Sale and Other Dealings with Emission Allowances and Credits) made under the *Climate Change Mitigation and Low-carbon Economy Act, 2016*. It bans the purchase, sale, and trading of emission allowances and credits by businesses and industries in Ontario. This regulation was adopted without consultation with the public, contrary to section 16 of Ontario's *Environmental Bill of Rights* (see section 2.2 of this report). For many good reasons, the *Environmental Bill of Rights* requires the government to give notice and consult the public before making environmentally significant decisions.

The regulation was adopted without public consultation.



Also without public consultation, the government introduced Bill 4, the *Cap and Trade Cancellation Act, 2018*. Bill 4 contains nothing of substance except to dismantle the previous framework. It proposes to revoke the *Climate Change Mitigation and Low-carbon Economy Act 2016* (the *Climate Act*) along with any emission reduction obligations for Ontario emitters, and the province's statutory GHG emission reduction targets. If Bill 4 passes as is, Ontario will have no

statutory emission targets, no pathway to achieve meaningful targets, weak reporting, no financial incentive for climate polluters to reduce their emissions, and no dedicated source of funding to invest in solutions.

The bill calls for the eventual establishment of new targets and a new climate change plan. However, because the new targets will not be enshrined in law they will have much less significance and will not provide reliable long-term guidance, as the government will be free to change them.

The bill introduces retroactive changes to the criteria for spending the remaining cap and trade auction revenues. The bill converts the Greenhouse Gas Reduction Account (which records the revenues from allowance auctions) into the Cap and Trade Wind Down Account. The government is no longer obliged to use these funds for GHG reduction projects, as was specified in the *Climate Act*. Although there are a number of options specified in the bill as legal ways to use this money, it is unclear what will happen to any unused funds remaining in the account.

If Bill 4 passes as is, Ontario will have no statutory emission targets, no pathway to achieve meaningful targets, weak reporting, no financial incentive for climate polluters to reduce their emissions, and no dedicated source of funding to invest in solutions.

Table 1.2. A comparison of the *Climate Change Mitigation and Low-carbon Economy Act, 2016*, and Bill 4, the proposed *Cap and Trade Cancellation Act, 2018*.

Characteristics	Act		Comments
	Climate Change Mitigation and Low-carbon Economy Act, 2016	Bill 4, proposed *Cap and Trade Cancellation Act, 2018*	
Long-term climate targets enshrined in law	Yes	No	Bill 4 states the government will set targets, which it can change at any time. No criteria for targets
Emission reduction obligations for emitters	Included	No	
Climate change plan	Required	Required	Unlike the *Climate Act*, Bill 4 has no legal obligation to achieve targets or to set out actions to achieve them
Carbon price	Included	No	
Reinvesting revenues in solutions	Required	Not applicable	Bill 4 eliminates carbon-pricing revenues. Unclear what will happen to unused funds raised by cap and trade.
Public consultation	Undertaken	Underway	This refers to compliance with the *Environmental Bill of Rights*
Annual progress report toward targets	Included	Optional	

1

Wiping out past emission reduction obligations

In revoking the *Climate Act*, Bill 4 would retroactively eliminate all emission reduction obligations for Ontario emitters over the period that the cap and trade program was in effect (January 1, 2017 to July 3, 2018). This punishes organizations that prepared for compliance with the law in good faith, and rewards those that did not.

> …This punishes organizations that prepared for compliance with the law in good faith, and rewards those that did not.

Ontario emitters that were subject to compliance obligations under the *Climate Act* must report emissions that occurred during the program period, but only so the government can decide whether they qualify for compensation for having bought excess compliance instruments such as allowances and offsets (see below).

Uncompensated losses

Compliance entities (and other market participants) in Ontario, Quebec and California possessed Ontario allowances that were purchased at auction (about $2.9 billion), and on the secondary market. Some were also issued allowances for free. As tradeable assets, some of these allowances had been bought, sold, used as collateral or were otherwise involved in commercial transactions. Virtually all these allowances will now be valueless.

> …with most losses remaining uncompensated.

This will inflict unanticipated financial losses on an undetermined number of organizations and individuals, including:

- Ontario buyers of allowances and offsets
- Ontario entities that invested in carbon reduction projects
- Ontario emitters that were eligible for free allowances, and
- out-of-province entities that were holding allowances and offsets in Ontario accounts.

Bill 4 outlines how compensation will be calculated, and limits it to a very small number of entities. The government has estimated this amount to be less than $5 million in total, with most losses remaining uncompensated. The bill claims to protect the government from civil liability for its actions. The courts will have to determine the effect, if any, of this provision, especially as against out-of-province entities. Federal taxpayers may ultimately be required to compensate out-of-province entities under NAFTA and international trade law.

Who Gets Compensation?

Under Bill 4, the government would provide no compensation to holders of allowances in the following circumstances.

- The allowances were provided free of charge (133 large climate polluters received most of their allowances free to make it easier for them to remain competitive against businesses in other jurisdictions. In some cases, the free allowances were used as collateral for loans to pay for low-carbon investments, loans for which these companies remain on the hook).
- The allowances matched or were less than the entity's emissions between January 1, 2017 and July 3, 2018.
- The costs of the allowances were passed through to consumers (distributors of natural

gas and transportation fuel were able to pass on their cap and trade compliance costs to their customers through increased prices, and generally did so).

- The holders of the allowances are market participants, e.g., traders.
- The allowances were for the 2021 vintage year.

The bill would limit compensation to those entities that purchased more 2017-2020 allowances than necessary to match their January 1, 2017 to July 3, 2018 emissions, and did not pass on the cost of the allowances to consumers.

Winners and losers

The resulting *winners and losers* will include climate polluters and other entities that:

Winners:

- did not buy or keep enough compliance instruments to match their GHG emissions between January 1, 2017, and July 3, 2018

Losers:

- bought allowances to match their emissions in good faith, when their competitor(s) did not
- invested time, talent and money in GHG reduction projects
- planned to sell some allowances to pay for low-carbon investments
- purchased 2021 vintage allowances, and
- market participants who held Ontario allowances.

Also included are California and Quebec, whose joint carbon cap now has an excess of Ontario allowances that represent about 13.2 million tonnes of CO_2e emissions.

1.4.2 Challenging the federal carbon price

Under the Pan-Canadian Framework on Clean Growth and Climate Change, the federal government will apply its two-part carbon tax (i.e., the federal backstop), beginning January 2019, on any province or territory that did not have a carbon pricing plan by September 1, 2018. The federal carbon pricing law (the *Greenhouse Gas Pollution Pricing Act*) has received Royal Assent and can be applied to Ontario at any time by direction of the federal Cabinet (see section 3.3 for more detail). However, the federal regulations that will set out final details of the backstop have not yet been adopted.

Over time, the federal carbon price is expected to become substantially higher than the carbon price established through the cap and trade system. The higher federal price will likely result in more revenues being collected under the federal carbon backstop, but also higher costs for products such as gasoline and natural gas. However, as the federal government has indicated that it will return all the revenue to Ontarians (which might include a carbon dividend), many Ontario residents, possibly the majority, might end up better off financially under the federal system.

Many Ontario residents, possibly the majority, might end up better off financially under the federal system.

The story is less clear for businesses, as the final design of the federal backstop for industry (i.e., the output-based pricing system) has not yet been established. As discussed in section 3.3.2, efficient large emitters capable of meeting the backstop's GHG performance benchmarks would not pay a carbon price. In contrast, the fossil fuel costs of smaller emitters not subject to the output-based pricing system would be considerably higher than under cap and trade.

We need clarity around the costs and regulatory implications for our business in the absence of cap and trade

Brenda Stenta–Corporate Communications Manager of steel producer Algoma

Many businesses are now uncertain about how the federal carbon backstop will affect them.

On August 2, 2018, the provincial government announced its intention to join Saskatchewan and spend $30 million challenging the constitutionality of the federal carbon pricing system in court. Given the importance of putting a price on carbon pollution, the ECO disagrees with the provincial government's plan to fight the federal backstop (see section 3.3.2). The ECO considers this plan ill-advised for many reasons, including the importance and effectiveness of putting a price on GHG pollution.

1.4.3 Damage to climate progress

Low-carbon projects ended across Ontario

Under the *Climate Act*, the government was legally obligated to use the cap and trade revenues (recorded in the Greenhouse Gas Reduction Account) on initiatives that reduce or support the reduction of GHG emissions. Fifty initiatives and more than 500 organizations received funds from this account, as described in section 1.3 and in Appendix B.

Without notice to or consultation with the public, the new government quickly cancelled all these initiatives and many of the approved funding commitments and contracts, even though it still had nearly $1 billion of revenues in hand from allowance auctions. Some of the impacts are described here and in Appendix B.

The cancelled initiatives (among 50) include the following:

- GreenON, which helped homeowners, social housing residents, businesses and industries reduce energy use and lower the costs of heating/cooling buildings and running equipment
- the School Retrofit Program: this program had $200 million for improving the energy efficiency of Ontario schools by, for example, repairing roofs, and updating cooling and heating systems, and
- the Ontario Municipal Commuter Cycling Program: this program awarded 120 municipalities with funding for new bike lanes and other cycling infrastructure.

The government has also demanded that many funds, already paid, be returned.

Not only would no further funds be provided (with some exceptions for wind down costs); the government has also demanded that many funds, already paid, be returned by recipients. Recipients may also receive little or no compensation for the time, talent and money they had invested in good faith in reliance on government contracts. No information is available as to how many of the approved projects will now fail or be abandoned, nor what will be the fate of the matching funds that had been raised. Many of the resulting losses will fall on public sector (i.e., taxpayer-funded) organizations, such as municipalities, hospitals, school boards, colleges and universities, and social housing providers. The losses will also fall on First Nations.

Many of the resulting losses will fall on public sector (i.e., taxpayer-funded) organizations.

Lost project – Town of The Blue Mountains

In July 2018, the government revoked cap and trade funds from a project in the Town of The Blue Mountains that would have reduced climate pollution, garbage odour, truck traffic, and municipal ratepayer costs.

Contaminated leachate from The Blue Mountains' landfill site in Grey County is hauled by multiple trucks every day to a wastewater treatment plant, at a high financial and environmental cost. Local residents are affected by the truck traffic and offensive odours.

To solve these problems, the Town developed an effective solution – a solar-powered pressurized pipe to transport the leachate to the wastewater treatment plant. The pipe would replace 700 truck trips each year, reduce odours, cut GHG emissions by 25,000 tonnes, and save municipal ratepayers over $75,000 a year. According to Town Project Manager, Jeffrey Fletcher, *"this was an ideal example of using Ontario's cap and trade program to financially assist municipal projects with multiple community and environmental benefits."*

In February 2018, the province awarded $2.3 million from cap and trade revenues to the project, which would cover 90% of the project costs. The town was to contribute in-kind support and use operational savings to cover the rest. Construction was on track to start in 2019. In July 2018, the province terminated the agreement. The pressurized pipe is now unlikely to go ahead, and the leachate will continue to be trucked.

Truck used to dispose of landfill leachate in The Blue Mountains.

Photo credit: Town of The Blue Mountains.

A number of Ontario companies have expressed concern about this lost funding. For example, Algoma, a steel producer and the largest employer in Sault Ste. Marie, has questioned the continued viability of its planned multi-million-dollar investment in GHG emission-reduction projects at its plant. These projects would have reduced Algoma's ongoing energy costs, and contributed to its competitiveness.

Lost project – Haliburton community wood heating

Energy costs are a big issue in many rural parts of Ontario. The combined effect of high energy costs and the availability of cap and trade revenues led Haliburton and neighbouring towns to pilot a local wood-fueled district heating system and a public-private utility to manage it.

Haliburton Village is near a working forest – Haliburton Forest, Canada's first certified sustainable forest and the largest private employer in Haliburton County – that could provide a sustainable source of locally grown, renewable fuel. With $2.8 million from provincial cap and trade revenues, plus $3 million of its own money, the municipality of Dysart et al (which includes Haliburton Village) partnered with Haliburton Forest and TorchLight Utilities, a bioenergy consulting firm, to pilot a wood-fueled district heating system.

The system would have provided heat to 45 commercial, institutional, and multi-unit residential buildings, slashing GHG emissions and cutting heating bills by 20-30%, while keeping more money in the local economy and generating up

Energy costs are a big issue in many rural parts of Ontario.

to $40,000 annually in municipal revenues. It would also have supported local jobs in the nearby forest, and set a valuable precedent for neighbouring municipalities.

"Like many areas of the province, Haliburton Village lacks low-cost natural gas, which means that it must be creative by looking to alternatives," says Malcolm Cockwell, Managing Director of Haliburton Forest. "This project was going to lower heating costs, create local jobs, support sustainable forest management, and keep energy expenditures within the community – while reducing greenhouse gas emissions."

Instead, the government has requested the return of the money already paid to Dysart et al. Without it, the project will not go ahead as planned, though a scaled down version may still be possible someday. "We hope to revive the project at some point in the future," says Cockwell. "But the timeline is unclear."

Figure 1.47. Haliburton Village's proposed wood-fueled district energy system, aerial view.

Photo credit: TorchLight Bioresources Inc.

Rendering of proposed Haliburton Village Energy Centre, front view.

Photo credit: Ivan Saleff Architect.

1.4.4 Impacts on key relationships

The way Ontario managed its withdrawal from cap and trade, and cancelled long-standing contracts, may have damaged key relationships with some of Ontario's largest trading partners, and made it more difficult to attract clean economy investments in Ontario.

The way Ontario managed its withdrawal from cap and trade, and cancelled long-standing contracts, may have damaged key relationships and made it more difficult to attract clean economy investments in Ontario.

For example, Ontario's failure to give the called-for notice of its decision to withdraw had the potential to destabilize the joint carbon market with Quebec and California, although market monitoring showed it did not have a major effect on prices in the secondary market. Quebec and California are two of Ontario's largest trading partners. Approximately $42 billion of Ontario products are exported to Quebec – one-third of Ontario's interprovincial exports. Similarly, Ontario products valued at about $30 billion are exported to California every year – 13% of Ontario's international exports.

A number of businesses in California and Quebec will have good reason to be angry with (and possibly sue) Ontario, and may also sue the federal government under chapter 11 of NAFTA. Cap and trade market participants in California and Quebec had purchased about $250 million in Ontario carbon allowances, which may dilute the effectiveness of the emission caps in their carbon markets, and eventually depress prices. In addition, businesses and investors outside Ontario may have suffered losses from the cancellation of contracts for renewable energy and other GHG reduction projects in Ontario.

1.4.5 Damage to clean economy investment in Ontario

Any effective climate policy for Ontario will require private sector investment in clean economy equipment and innovations (see section 1.5). The Ontario government's recent conduct may make it more difficult to attract such investment. Regulatory uncertainty and evidence that the provincial government does not always honour its contracts increases the business risk of investing in Ontario, especially where compensation cannot be counted upon. Although the government indicates that it will provide some funding for new technologies to reduce Ontario's emissions, the promised amount is a tiny fraction of the funds that were available from cap and trade.

Cancelling support for electric trucks has cost Ontario potential manufacturing jobs

Ontario's elimination of support for electric trucks has cost the province a valuable manufacturing opportunity. Following Ontario's announcement of the Green Commercial Vehicle Program in 2017, the world's largest electric vehicle maker (Warren Buffet-backed, China-based BYD) announced plans to build its first Canadian assembly plant. Electric trucks were to begin production in Ontario in 2018.

Financial support to purchase electric trucks was provided through the Green Commercial Vehicle Program. However, this program was funded through the now-cancelled cap and trade program. This means that the company is without sufficient demand to proceed with the project. BYD has informed the ECO that its plans can change if the government creates a new program to support electric commercial vehicles. A revenue-neutral feebate is one way the government could stimulate demand for zero emission vehicle manufacturing in Ontario.

1 The government's unilateral cancellation of contracts harms business investment and investor confidence.

Business groups, such as the Ontario Chamber of Commerce and the Business Council of Canada, have clearly stated that the government's unilateral cancellation of contracts and/or setting of compensation terms harms business investment and investor confidence. The last-minute aborted launch of Climate Solutions Group's $25-million Ontario investment fund in July 2018, after a year of development, illustrates how some companies are reacting.

> *"The sanctity of contracts is fundamental. The government unilaterally cancelling contracts is harmful to business investment in Ontario."*
>
> Ashley Challinor–Director of Policy, Ontario Chamber of Commerce

Many businesses hurt by the government's recent decisions had been confident in investing in Ontario due to its hard-earned reputation for having a stable and predictable regulatory and legal environment. As these businesses potentially face millions of dollars in uncompensated liabilities, they (and others) may invest elsewhere instead. They can also be expected to spread the word about their adverse experiences in Ontario.

Renewable energy projects cancelled all over Ontario

In addition, the new government cancelled, without notice or public consultation, 752 renewable electricity contracts (including large projects >500 kW) across Ontario. (Although it has been reported that 758 projects were cancelled, some of these projects had been voluntarily cancelled before the government announcement). This decision will have climate impacts, as some of this renewable electricity will be replaced with fossil fuels. Those adversely affected include hydropower developments, First Nations economic development projects, farm-based biogas digesters, community energy cooperatives, public utilities, municipalities, school boards, conservation authorities, and numerous small Ontario businesses.

The new government cancelled, without notice or public consultation, 752 renewable electricity contracts across Ontario.

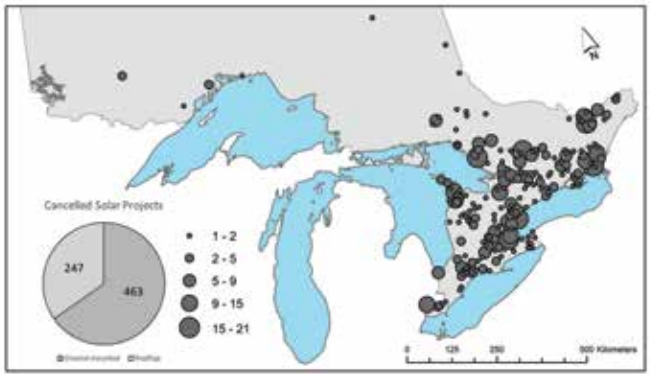


Figure 1.48. Locations of the cancelled solar projects.

Source: Department of Geography, Environment and Geomatics, University of Guelph.

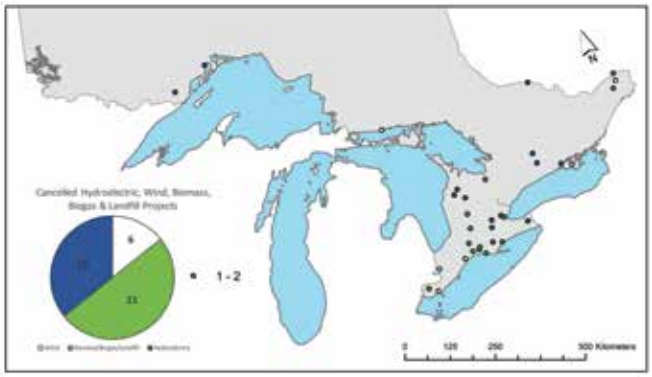


Figure 1.49. Locations of the cancelled wind, biomass, biogas, landfill and hydroelectric projects. This map includes the White Pines wind project (see below).

Source: Department of Geography, Environment and Geomatics, University of Guelph.

Ten of the cancelled projects were large projects that had won an international competitive bid to supply renewable power to Ontario at the lowest available price. Of the 103 proposals received by the Independent Electricity System Operator, 16 had been awarded contracts after a rigorous two-year evaluation and had since been working through Ontario's consultation and approval process. Ten of these 16 contracts have now been summarily cancelled, including those in the table below.

Ten of the cancelled projects had won an international competitive bid to supply renewable power to Ontario at the lowest available price.

Table 1.3. Descriptions of the ten cancelled large renewable energy projects.

Large Renewable Project	Renewable Fuel	Project Capacity (kWAC)	Location of Project	Aboriginal Participation
Strong Breeze Wind Project	Wind	57,500	Dutton	Fort Severn, Poplar Hill, McDowell Lake, North Spirit Lake, Keewaywin and Deer Lake First Nations
Otter Creek Wind Farm Project	Wind	50,000	Wallaceburg	Walpole First Nation
Eastern Fields Wind Farm	Wind	32,000	St. Bernardin	N/A
Sky One	Solar	11,760	Burks Falls	Missanabie Cree First Nation
Trenton Lock 1 Hydro Project	Water	7,000	Trenton	Dokis First Nation (Dokis Indian Band #9)
Lake Simcoe Regional Airport Solar Project	Solar	6,750	Oro Station	Fort Severn, Poplar Hill, McDowell Lake, North Spirit Lake, Keewaywin and Deer Lake First Nations
Lock 25 Generating Station	Water	3,000	Near Lakefield	N/A
Peterborough Utilities Lock 24 Hydro	Water	3,000	Selwyn	Curve Lake First Nation
Peterborough Utilities Lock 31 Hydro	Water	2,500	Buckhorn	Curve Lake First Nation
FiniteLight Solar Project	Solar	1,375	Picton	Sachigo Lake First Nation

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The disproportionate effect on First Nations communities

The renewable energy project cancellations may result in substantial losses for First Nations communities. First Nations had equity stakes in 8 of the 10 large renewable energy projects that were cancelled.

For example, Curve Lake First Nation, a small community of 2,700 outside Peterborough, lost its 15% equity stake in the development of two multi-million dollar hydro projects that would have generated enough low-carbon electricity to power about 2,000 households.

"It would have been a boost to the local economy in terms of local jobs, services, materials, equipment rentals," said John Wynsma, Vice-President of Generation at Peterborough Utilities. "Furthermore the profits would have been reinvested locally both in the City of Peterborough and Curve Lake First Nation community."

The projects were cancelled after $1.5 million and thousands of hours were invested on environmental impact studies. As a result, the community may lose more than $75,000, in addition to economic growth opportunities. About 50 construction-related jobs, multiple maintenance jobs, and a stable revenue stream were anticipated over the 20-year life of the power projects.

Zac McCue, a member of Curve Lake First Nation who helped develop the projects, said of the decision: "It is incredibly short-sighted and backwards looking in terms of reconciliation and local economic opportunities, not to mention reducing our emissions."

Whether the government can cancel these projects may ultimately be determined by the courts.

Whether the government can cancel these projects may ultimately be determined by the courts.

The government also took the extraordinary step of cancelling, by legislation (through the *Urgent Priorities Act*, *2018*), another large renewable energy project: the nine-turbine White Pines wind project that held all legal approvals and was under construction in Prince Edward County. The White Pines project developer (wpd Canada) had been awarded its power purchase contract in 2010, and had successfully proceeded through Ontario's renewable energy approval process ever since. Opponents' appeal of the renewable energy approval had been settled, and the project had received its final go-ahead from the Environmental Review Tribunal in May 2017. The *Urgent Priorities Act, 2018* nullifies all applicable contracts and approvals, orders the company to tear the whole project down at its own expense, and allows the government to determine the amount of compensation, if any, by regulation at some unspecified future date.

The government cancelled a wind project that held all legal approvals and was under construction.

"But do you think … that it is fair and equitable that a project right before completion is now being ruined retroactively and that our company is suffering serious damage through no fault of its own?"

-Dr. Harmut Brösamle, CEO of the company developing the White Pines project

The *Urgent Priorities Act* contains extraordinary language for a province that usually prides itself on being governed by the rule of law. In this act, the government legislates that the government and all individuals responsible for the law are retroactively immune from liability for a wide range of wrongs, including breaches of:

> *contract, restitution, tort, misfeasance, bad faith, trust or fiduciary obligation, or any remedy under any statute (Schedule 2, s. 5(2), Schedule 1, s.6(2)).*

These renewable energy projects were integral to increasing the province's clean energy capacity.

All these renewable energy projects were planned components of Ontario's clean energy capacity, and were part of Ontario's Long-Term Energy Plan. These projects were paid for without cost to the provincial government, in exchange for long-term power purchase contracts awarded over several years by the Independent Electricity System Operator. They were not part of or related to cap and trade, although they were important components of clean, distributed energy to build a resilient low-carbon economy across Ontario.

Window contractors impacted by cancelled GreenON funding

Small businesses across the province have been left scrambling to meet tight deadlines brought about by the government's cancellation of GreenON energy efficiency programs, funded by cap and trade revenues.

The programs included rebates for high efficiency windows – up to $5,000 per home – and for better insulation and low-carbon heat pumps. One renovation company called it "an unbelievable window of opportunity." Hundreds of customers took advantage of the rebates between January and June 2018, boosting demand for window installers and other contractors.

But in June, the government cancelled GreenON and set an October 31 deadline to complete all orders. Some window companies are worried this will affect their business and reputation.

Pat Hunter, president of Ottawa-based Comfort King Windows & Doors, has $850,000 in outstanding contracts. "I'd love to get everything done by October 31. Nothing would make me happier. But it's not going to happen," he said. Despite working "like crazy" to meet the deadline, he expects that up to half of his orders will remain unfulfilled.

"It could be detrimental to the reputation of my business," Hunter said, adding: "I've always respected a contract… and suddenly the government doesn't want to live up to this contract. I'm just hoping that the government realizes that I'm not the only company in Ontario with this problem."

Michael Braby, president of Aaben Windows and Doors Ltd. in Kingston, says he will struggle to finish work for about 100 clients in time, putting $180,000 worth of rebates at risk. "It's not income tax," Braby said of the rebates. "It's not coming from everybody, it's a pool of money to the tune of some $2 billion that's already there."

1

Without a climate policy, Ontario's climate pollution will grow, we will not meet our commitments, and we will lose out on good jobs, clean air, lower health costs and more.

1.5 Ontario needs climate action

Abstract

In 2018, after another year of blazing heat, wildfires, floods and storms, Ontario cannot afford to stop taking strong action on climate change. Climate change is an urgent and potentially irreversible threat to humans, the environment, and economies; the window for stopping its worst impacts is closing fast. Like all other countries, Canada has accepted international obligations to reduce its emissions and must honour them, and Ontario – Canada's second biggest emitter of greenhouse gas emissions – must do its share.

A strong climate policy is also essential to a durable health and economic policy. Fossil fuels are the major source of air pollution in Ontario cities. And Ontario depends on importing fossil fuels for 80% of our energy needs, draining $11 billion out of the province every year, and making us vulnerable to international price fluctuations. A strong, stable and predictable climate policy would drive greater efficiency in the use of fossil fuels, keep more money circulating in Ontario, as well as support job creation and Ontario's clean technology industry.

There will be challenging adjustments along the way, and we must all be willing to make some changes and some sacrifices. But the changes we need seem harder and scarier than they really are. Strong climate policies may slightly slow projected economic growth. We can choose small reductions in economic growth now or much bigger losses in the very near future. We are fooling ourselves if we pretend that we can somehow avoid both.

Contents

A climate change strategy is critical .... We look forward to continuing to work together, and with our fellow premiers, to create good jobs and drive economic growth across the country.

From the July 19, 2018, joint statement of Ontario Premier Doug Ford and Saskatchewan Premier Scott Moe.

1

1.5.1 The climate imperative

The new provincial government promises climate action. To date, its actions have seriously damaged climate progress in Ontario. The provincial government now needs to show leadership. How will it drive significant greenhouse gas (GHG) emissions reductions across the province, towards solid, science-based targets?

As outlined in section 1.1, climate disruption is here and getting worse. It is already clear that the climate of the future will be drastically different than what we and our ancestors experienced. Every tonne of GHGs that we emit contributes to the growing damage, and worsens the options for our children and grandchildren.

The longer we wait, the more it will cost.

The cost of delay

For climate action in Ontario, and around the world, the longer we wait, the more it will cost. Since the Stern Review in 2006, it has been clear that every year of delay reduces the options and increases climate damage. The evidence gathered by the review showed that "ignoring climate change will eventually damage economic growth."

Climate change is an expensive problem to deal with, but the cost of doing nothing is much larger. Don Forgeron, President and CEO of the Insurance Bureau of Canada, notes that "severe weather due to climate change is already costing Canadians billions of dollars annually." The most recent Canada-wide study estimates that climate disruption will cost Canada $5 billion per year by 2020, and will increase to between $21 billion and $43 billion per year by 2050. These costs, which are described in further detail below, will be felt by all – provinces, territories, municipalities, businesses, industries and citizens.

Keeping our word

Amidst growing concern and mounting damage from the impacts of climate change across the globe, world leaders agreed in 2015 to work together to tackle climate change. This was an incredible achievement. After years of failed negotiations, 195 national governments from around the world, including Canada, signed the Paris Agreement – the largest number of countries ever to sign an international agreement. These countries committed to work toward keeping the global average temperature increase well below 2°C compared to pre-industrial levels, and ideally below 1.5°C. These temperatures are significant thresholds against the worst and irreversible impacts of climate change. A special report on pathways to limit global warming to 1.5°C, and the associated implications of this target, is being prepared by the Intergovernmental Panel on Climate Change and is scheduled for release in October 2018.

In signing the Paris Agreement, each country committed to set GHG-emission reduction targets in order to contribute to the common goal, and every country committed to keep its word and to deliver those reductions. Canada pledged to reduce its GHG emissions 30% from its 2005 level by 2030. Although our population is relatively small, Canada is one of the world's top ten largest GHG emitters. Canada also played a prominent role in negotiating the Paris Agreement, and is watched carefully by other countries.

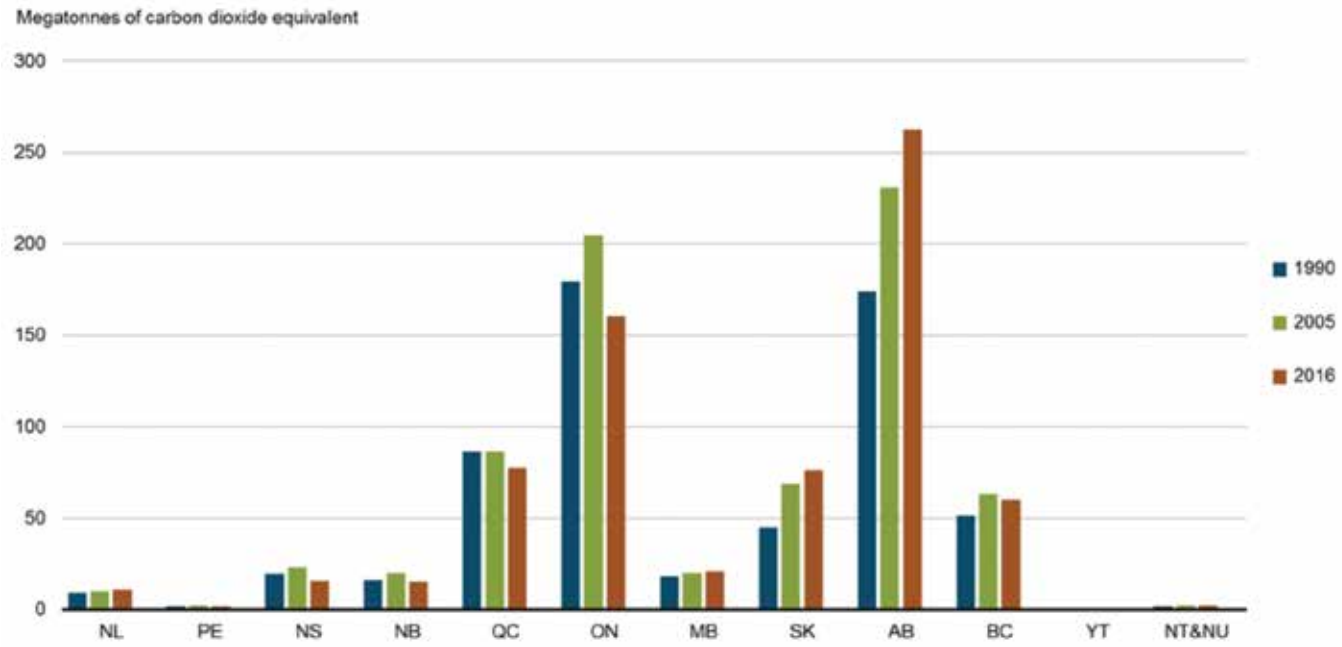

Figure 1.50. Total greenhouse gas emissions by Canadian province and territory, 1990, 2005 and 2016.

Source: Environment and Climate Change Canada (2018).

Ontario plays a critical role in Canada's commitment to the world. Ontario is the second largest GHG-emitting province in Canada, with high emissions per person. If rich jurisdictions like Ontario and Canada, do not do their part, we cannot expect poorer jurisdictions around the world to reduce their emissions either.

Although our population is relatively small, Canada is one of the world's top ten largest GHG emitters.

Reaching these goals will not be easy. The world has very little time left to avoid passing these thresholds. Achieving these temperature limits requires immediate and massive cuts to GHG emissions by most countries. Scientists warn that global emissions need to stop rising by 2020, only two years from now, followed by an accelerated rate of reductions to bring emissions down to zero between 2050 and 2100. If those goalposts are missed, the next generation will need to find a way to remove huge amounts of GHGs from the atmosphere, in addition to reducing their own emissions to zero. Global economic and population trends will make emissions reductions extremely difficult. Moreover, the total pledges made by all signatory countries to date are not stringent enough to keep the world from warming more than 2°C. However, the Agreement and pledges mark an important starting point, with the best hope the world has seen to date of increased reductions later.

1

The risk of liability

The demand for accountability for climate change has contributed to a wave of legal challenges washing over governments and big climate polluters around the world. Over the last few years, the number of lawsuits has increased, and complainants are starting to win some battles.

A recent study by the United Nations Environment Programme and Columbia Law School revealed that, as of March 2017, climate change cases have been filed in 24 countries. The majority of the lawsuits have occurred in North America; 13 cases had been filed in Canada. The study identified five key trends in climate change litigation:

- holding governments to their legislative and policy commitments
- linking the impacts of resource extraction to climate change and resilience
- establishing that particular emissions are the proximate cause of particular adverse climate change impacts
- establishing liability for failures (or efforts) to adapt to climate change, and
- applying the public trust doctrine to climate change.

For example, in 2016, Muskoka residents and business owners filed a class action lawsuit seeking $900 million in damages from the Ministry of Natural Resources and Forestry for damages to property "arising from failure to adapt to changed climatic circumstances and thereby avert flood damage."

Key cases in the U.S. include a 2007 lawsuit that forced the U.S. Environmental Protection Agency to regulate GHG emissions because GHGs are a public health threat. In 2015, a group of 21 children filed lawsuits against the U.S. government and various state governments, claiming that the governments exposed them to the dangers of climate change by supporting policies that favour the use of fossil fuel energy. Attempts by the federal government to block the case were rejected by the U.S. Supreme Court on July 30, 2018; a trial date has been set for October 29, 2018. Internationally, the Dutch government was ordered to lower the country's GHG emissions in response to a 2015 class action lawsuit from its citizens.

Climate litigation is becoming a reality for industry.

Not only are governments being called to account; climate litigation is also becoming a reality for industry.

- In 2017, three local governments in California filed a lawsuit against 37 fossil fuel companies, alleging that the companies knew about the impacts of climate change and failed to act. The governments are seeking billions of dollars in damages from rising sea level due to climate impacts. In 2018, a U.S. District Court ruled that California state courts were the appropriate setting for the climate lawsuits.
- The Philippines Human Right Commission, on behalf of 13 organizations and 20 individuals, is investigating whether 50 companies, who are major emitters of GHGs, infringe the human rights of those who suffer from climate damage.
- RWE AG, a major German power company, lost a motion to block a lawsuit for climate damage from a Peruvian villager, Saúl Lliuya.

See also The Carbon Boomerang: Litigation Risk as a Driver and Consequence of the Energy Transition and the ECO's 2015 Greenhouse Gas Progress Report: Feeling the Heat.

The growing global awareness of the responsibility of governments and major GHG polluters to reduce GHG emissions and prepare communities for climate change will continue to fuel climate litigation across the globe. Taxpayers and those who suffer climate damage cannot alone bear the costs of climate change, which continue to rise. Cases like these may expose governments, industry and business to growing financial, reputational, and legal risks.

1.5.2 *Economic benefits of reduced reliance on fossil fuels*

Reducing Ontario's fossil fuel use will reduce GHG emissions, and provide environmental, health and economic benefits. Ontario depends on fossil fuels for about 80% of the province's energy, most of which is imported, at a cost of over $11 billion/year. To become more efficient and self-reliant, and keep more of that money here, Ontario must both:

- conserve energy by improving energy efficiency, and
- switch from fossil fuels to Ontario's low-carbon electricity (see section 3.1).

Reducing Ontario's fossil fuel use will reduce GHG emissions, and provide environmental, health and economic benefits.

Reducing the province's reliance on fossil fuels has the added economic benefit of potentially stimulating Ontario's cleantech sector. As a leader in cleantech, the continued growth of this sector is vital to Ontario remaining competitive and attractive to international investment. It also plays a key part in strengthening Ontario's economy as the province continues its transition to the new low-carbon world. Seventy-eight percent of Canadian Federation of Independent Business members believe "it is possible to grow the economy and protect the environment at the same time."

As well, reducing Ontario's fossil fuel use would help limit the economy's vulnerability to oil and gas price shocks (see Figure 1.51).

For a summary of major co-benefits of reducing Ontario's reliance on fossil fuels, see Figure 1.52.

Public health and productivity

Burning petroleum products, like gasoline and diesel, creates air pollution that damages human health.

Many studies have quantified the health system costs of dirty air as well as the negative impacts on economic productivity. It has been most clearly studied by the nine U.S. states who work together in North America's first cap and trade program for GHGs, the Regional Greenhouse Gas Initiative. Once cap and trade came into effect, the electric power sector in these states cut its coal-fired power generation from 23% of overall generation in 2007 to 7% in 2015, reducing GHG emissions by 40%. As a result, air pollution in these states

Figure 1.51. Major events and world oil prices 1997-2017 in US dollars per crude barrel of oil ($US/bbl).

Source: U.S. Energy Information Administration (via Canadian Fuels Association, 2018).

Air pollution from fossil-fueled vehicles remains a significant threat to public health.

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was slashed, resulting in an estimated US$5.7 billion in health savings and other benefits, as measured by a retrospective analysis of the impact on air quality and public health. Every participating state has experienced health and economic benefits from this cleaner air.

Ontario has already closed its coal plants, but air pollution from fossil-fueled vehicles remains a significant threat to public health, especially to those who live, work and go to school or receive care along busy roads. Air pollution still contributes to 1,300 premature deaths and 3,550 hospitalizations per year in Toronto. According to Toronto Public Health, fossil-fueled cars and trucks are the most significant source of air pollution in the city, and reducing these emissions (and public exposure to them) is a public health priority. Public Health Ontario has shown a direct correlation between traffic-related air pollution and dementia. The closer a person lives to major roadways, the more likely they will suffer adverse health effects. For these reasons, vehicle electrification, public transit and active modes of transportation can also play an important role in improving local air quality and public health.

Ontario's cleantech sector presents a real opportunity for economic growth and job creation.

Ontario's cleantech sector

Ontario's cleantech sector presents a real opportunity for economic growth and job creation in the province. Years of investment and support attracted top businesses, talent and investment to Ontario. As a result, Ontario's cleantech sector has been the fastest growing of all Canadian provinces and territories. It generates $19.8 billion in annual revenue (international buyers source $1 billion in cleantech products from Ontario annually), includes 5,000 companies, and employs 130,000 people. Ontario's cleantech companies are also helping organizations and communities around the world implement technologies that address major environmental and sustainable development challenges (e.g., clean drinking water). For example, Ontario's Water Technology Acceleration Project has driven global innovation in clean water technology and given Ontario a competitive edge in this market.

The global market for low-carbon goods and services is already worth over US$5.8 trillion, and is projected to keep growing. Global commitments to transition to a low-carbon economy are driving the growing need for clean technology solutions.

The ECO understands that the sudden cancellations of cap and trade, renewable energy contracts and low-carbon projects across Ontario have dealt a blow to parts of this sector. To recover, the Government of Ontario will need clear, strong, predictable climate policies.

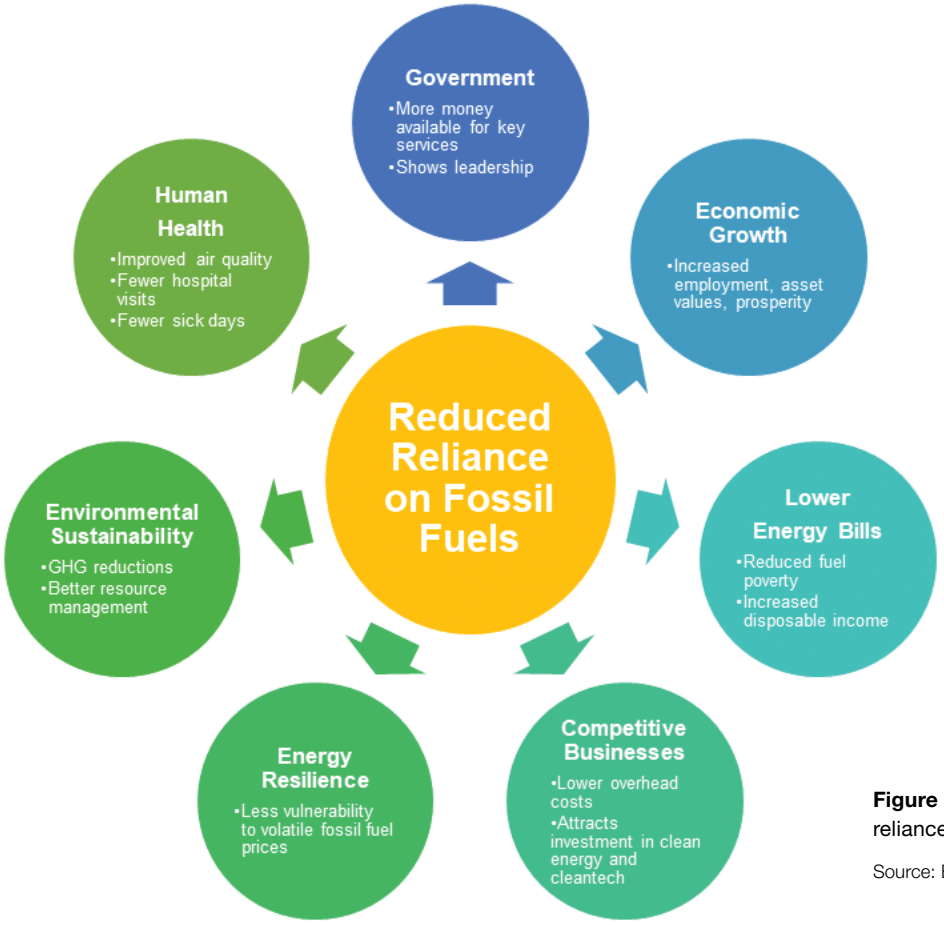

Figure 1.52. Major co-benefits of reducing reliance on fossil fuels.

Source: Environmental Commissioner of Ontario (2018).

1.5.3 Economic benefits of energy efficiency

Energy efficiency helps customers manage their power bills, helps businesses be competitive, creates jobs, and increases gross domestic product (GDP). In relation to electricity, increased efficiency also means the province has more Ontario-produced, low-carbon electricity available to replace fossil-fueled energy use.

By increasing energy efficiency, Ontario would keep some of the over $11 billion spent on fossil fuels each year. Those funds could instead be spent on local, energy efficiency jobs – good jobs that pay well. The resulting energy savings could also result in broader economic stimulation and job growth in other sectors.

Local economies and job markets can grow when business owners use their energy savings to expand their operations, and when households spend theirs on local goods and services. By one estimate, implementing increased energy efficiency in Ontario (as outlined in the Pan-Canadian Framework) could result in a net increase of about 52,900 jobs a year and $12.5 billion a year in GDP growth by 2030, even after accounting for some job losses in fossil fuel sectors.

Increased energy efficiency in Ontario could mean a net increase of 52,800 jobs/year and $12.5 billion/year (GDP)

"For every job installing energy efficiency measures, the energy these measures save creates between one and three more"

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Energy efficiency is the fastest-growing part of the U.S. energy sector. In 2017, it employed 2.25 million Americans – more than the coal, oil, gas and electricity production sectors combined. The U.S. energy efficiency sector is projected to grow by another 9-11% in 2018.

And this growth helps the economy as a whole. Research by the American Council for an Energy-Efficient Economy shows, "for every job installing energy efficiency measures, the energy these measures save creates between one and three more [jobs]." As well, energy efficient businesses are more competitive because they have more capital available to either invest in their services and products or can charge less for them.

Cost savings from using natural gas efficiently

Utility-run natural gas conservation programs delivered in 2015 will provide a net benefit to Ontarians of over $230 million from avoided natural gas use and reduced greenhouse gas emissions. The average Ontarian saved about $17 on their natural gas bill, after factoring in the costs to run and participate in the programs. These programs allow money to stay in Ontarians' pockets and be invested in Ontario businesses, goods and services. Saving on heating bills is particularly important for low-income households, who often can only afford energy-inefficient housing and, partly because of high energy bills, have less money available to undertake energy efficiency retrofits on their own.

Utility-run natural gas conservation programs in 2015 will provide a net benefit of over $230 million.

These same economic arguments apply to Ontario's electricity conservation programs, which produced over $500 million in net benefits in 2016. Energy efficiency is the least expensive way to counter the need for new energy sources in the province. Electricity conservation has the added benefit of ensuring Ontario has more low-carbon energy available to help Ontarians transition away from their fossil fuel dependence.

Beyond utility-run conservation programs, many conservation measures and retrofit opportunities can significantly reduce energy reliance in homes and business. For large businesses, these can mean big savings – sometimes in the range of hundreds of thousands of dollars a year – on operating expenses. What's more, improving the energy efficiency of buildings can also result in increased building and rental values.

As the ECO has outlined in previous reports, many public buildings and facilities, like Ontario's water and wastewater plants, are incredibly energy intensive. If the Ontario government and broader public sector were to capitalize on potential energy efficiency savings, it could mean fewer tax dollars paying for energy bills, and more tax dollars available to pay for critical services, like roads, education, healthcare, and clean water. For example, a recent study shows the potential of one Ontario elementary school to reduce 36% of its natural gas use through energy efficiency measures, savings that could be spent on other things.

Reduced reliance on gasoline and diesel

Although the Government of Ontario has historically focused on electricity and natural gas conservation, there are major opportunities for the province to reduce Ontario's gasoline and diesel use. When it comes to transportation, increased energy efficiency and switching to lower-carbon fuel sources, such as electricity, brings economic, as well as important health and environmental benefits.

Currently about 13% of Ontario's low-carbon electricity is either sold to other jurisdictions or curtailed (turned

off) on off-peak hours (that is, generators are paid even though their facilities are not producing electricity). Ontarians could better take advantage of this low-carbon energy source, for example by charging electric and hybrid vehicles off peak (i.e., overnight and on weekends). Not only would this save fueling costs for car owners, but it could also reduce the cost per unit of electricity in the province. This is the case because even at off-peak prices, Ontario would be making more per unit of electricity than if it were exported, and certainly more than if it were curtailed. As a result, electricity system costs are spread over more units of electricity sold in the province, which drives down prices.

Limiting the air pollutants from cars and trucks, by switching to lower-carbon fuels, would also improve public health outcomes in the province, and lower health system costs. Finally, encouraging this sector would help Ontario's car manufacturers remain innovative and competitive, and provide growth opportunities for Ontario's cleantech sector.

Financial and economic opportunities for the transportation sector are further discussed in section 3.3.3.

Many municipalities want to do their part on climate change.

1.5.4 Local governments shouldn't have to act alone

Cities and towns account for more than 70% of global emissions due to high energy use. Municipal governments can affect these emissions both by controling key assets like buildings and vehicle fleets, and influencing the urban form built in their communities. Transportation and buildings are two of Ontario's highest GHG-emitting sectors.

Many municipalities want to do their part on climate change. Since 1994, over 350 Canadian municipalities have committed to taking action on climate change through the federal government's Partners in Climate Protection program; approximately 25% are from Ontario. In 2015, the Association of Municipalities in Ontario (444 municipal governments) and the Union of Quebec Municipalities signed a long-term Climate Change Action Covenant. This action sent a strong message to the federal and provincial governments that municipalities in Canada's most populated provinces were ready and willing to reduce emissions within their control and influence. As shown in Appendix B, municipalities were eager participants in Ontario's GHG reduction programs funded by cap and trade.

But municipalities have limited freedom of action. Today's uncertainty and a lack of clear policy direction make it difficult for them to make informed decisions and to work effectively towards a common goal. Smaller municipalities, in particular, face severe financial limits, and may lack the resources and capacity to act on their own. They need provincial leadership and assistance.

1.5.5 Pay a small economic price now, or much more later

The ECO is not suggesting that the transition to a low-carbon economy will be easy. It won't. There will be challenging adjustments along the way, and we must all be willing to make some changes and some sacrifices. But the changes we need seem harder and scarier than they really are.

As the federal Parliamentary Budget Officer (PBO), the Ecofiscal Commission and the Conference Board of Canada have reported, implementation of a federal carbon tax may slow economic growth in Canada a little in the next few years, depending on how the money is used. The PBO estimates that, if all carbon levy revenues are returned to households as lump-sum payments, the economy will continue to grow at 1.5% a year or more, about 0.1%/year lower than if emissions simply continued to rise. Over five years,

> *real GDP will be 0.5 per cent lower in 2022 compared to a scenario without a carbon pricing levy.*
>
> *PBO Economic and Fiscal Outlook, April 2018.*

This minimal economic impact can be made even smaller if governments use the carbon revenue better:

> *Were provinces and territories to undertake more efficient revenue recycling, such as reducing corporate or personal income taxes, the impact of the carbon pricing levy on the Canadian economy would be significantly lower.*
>
> *PBO Economic and Fiscal Outlook, April 2018*

In addition, the underlying models that predict these small reductions in economic growth (such as the Trottier Energy Futures Analysis referred to by the Conference Board of Canada, whose updated model is described in section 3.1 of this report) are incomplete because they focus more on the costs than on the benefits of climate action. For example, they often do not take fully into account the:

- public health and economic efficiency benefits of reduced use of fossil fuels
- rapidly dropping costs of cleaner technologies, which have repeatedly outpaced projections
- potential for changes in financial markets as climate risks become better understood, and
- steeply rising cost of climate damage if emissions are not reduced.

Governments have important roles to play because even small GDP reductions will not affect everyone the same. Government should help adversely affected industries and workers adjust to the changes; ensuring a just transition is part of its responsibility. But the hard fact remains that we can choose some reductions in economic growth now or much bigger losses in the very near future (see section 1.5.1). We are fooling ourselves if we pretend that we can somehow avoid both.

1.5.6 Conclusion

There are many reasons why Ontario needs to replace its lost climate programs with new ones that are at least as effective. In addition to the climate imperative, to our international obligations, and our self-interest in reducing climate damage, Ontario also has strong economic reasons to increase efficiency and reduce our reliance on imported fossil fuels. Energy efficiency and electrification could mean more money and better value for Ontarians – in people's pockets, in good jobs, in more competitive businesses, in attracting international investment, and in tax dollars going further, as well as better air quality and public health.

Social housing repairs on hold in Hastings County

Hastings County, an eastern Ontario municipality, planned energy efficiency retrofits at four social housing buildings to improve tenant comfort, reduce energy costs for the county, and cut GHG emissions from natural gas heating.

The project was dependent on $736,000 from the province's Social Housing Apartment Improvement Program for which the county had applied. Now, the county needs alternative support as the funding was cancelled in July 2018 – a "significant" loss according to the county's Director of Community and Human Services, as it would delay much-needed upgrades and repair work.

"It becomes almost like a download again – and we can't afford any more downloads," said Belleville councillor Garnet Thompson. The funding for retrofitting is "crucial" for municipalities. "This is an important part of our mandate to provide housing for the underprivileged in our communities. The county must maintain the homes it owns," he said. "If we don't we're going to get more people living on the street."

Local councillors are also concerned about the loss of future energy savings and impacts to municipal operating budgets. "We either cut the programs and let our buildings go, and people go without – or we send it back to the taxpayer," said Councillor Garnet Thompson, Chair of the Community and Human Services Committee.

The federal backstop is a good start. But Ontario needs a climate law of its own to get the best results for the province.

1.6 Why not leave climate action to the federal government?

The federal backstop is a good start

As described in section 1.3 of this report, the Canadian government, Ontario and most other provinces and territories agreed in 2016 to the Pan-Canadian Framework on Clean Growth and Climate Change (the framework). The framework contains four pillars, with the intended goal of helping Canada fulfill its international emission-reduction commitment under the Paris Agreement. The four pillars are:

- pricing carbon pollution
- complementary (other) measures to reduce emissions
- adapting to the impacts of climate change and building resilience, and
- accelerating innovation, supporting clean technology, and creating jobs.

To implement the "pricing carbon pollution" pillar, the framework includes a national backstop for provinces and territories that do not adopt their own carbon price. To implement this backstop, there is now a federal *Greenhouse Gas Pollution Pricing Act*. Because Ontario has abandoned its cap and trade system, the federal government stated that this backstop will apply in Ontario as of January 1, 2019. Details of the federal law and carbon backstop are presented in section 3.3.2.

The federal carbon backstop is not as good for Ontario as the cap and trade program that was cancelled. Still, the ECO cannot support the provincial government's plan to challenge the federal backstop in court. Now that cap and trade is gone, a federal carbon tax would restore a price on climate pollution to motivate and reward emission reductions. As described in section 3.3, a carbon tax on fossil fuels can be an efficient polluter-pay tool to both reduce emissions and provide funds to finance low-carbon solutions. The federal government's carbon tax backstop is therefore a good start.

The federal government's carbon tax backstop is a good start.

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But the federal backstop does not go far enough

The federal backstop is not a good enough substitute for a strong Ontario climate policy because it will not reduce emissions enough. The federal plan does include many good steps to reduce emissions from key emitting sectors, including transportation, buildings, electricity, and oil and gas. But:

- it will not reduce Canada's emissions enough to meet Canada's Paris Agreement commitment, and
- Canada's Paris Agreement commitment is itself too weak to keep climate damage manageable.

The federal government admits that, by itself, the framework is not enough to meet Canada's Paris Agreement commitment.

To meet its Paris commitment, the federal government estimates that Canada needs to find another 66 million tonnes of carbon dioxide equivalent in emission reductions by 2030; others estimate that the gap is more than twice that large. Ontario's wrenching halt to its climate progress, as described in section 1.4 of this report, may make the gap even larger.

The federal backstop will not reduce emissions enough.

Even if Canada were on track to meet its Paris Agreement commitment, its commitment is very weak. Under the Paris Agreement, every country sets its own emission-reduction target. Canada's emission reduction pledge is too small to help hold global warming well below 2°C, as all countries of the world have agreed to do. Climate Action Tracker, an independent scientific analysis, rates Canada's Paris commitment as highly insufficient.

Figure 1.53. Canada's climate change plan is rated as highly insufficient by Climate Action Tracker.

Source: Climate Action Tracker.

If all countries met commitments as inadequate as Canada's, global warming would reach between 3°C and 4°C during the next 100 years (see Figure 1.53), with potentially catastrophic consequences. The Paris Agreement therefore expects Canada, and other countries, to become more ambitious over time (e.g., to make, and meet, more rigorous emission reduction pledges).

A made-in-Ontario climate framework would get better results for our province

Whether or not the federal carbon tax backstop comes into effect in Ontario, the Ontario government still requires a climate law of its own to get the best results for our province.

If Ontario wants to keep the economic cost of the low-carbon transformation as low as possible, and maximize the jobs and economic benefits here, Ontario will need to take other measures within the exclusive jurisdiction of the provincial government.

Hamilton cuts costs and emissions thanks to social housing retrofits

The City of Hamilton's energy retrofits at 13 older apartment buildings are saving 28,400 tonnes of GHG emissions and $775,000 per year in energy costs, as well as maintenance costs. The retrofits were funded with $7.1 million of cap and trade revenues, via the Social Housing Apartment Retrofit Program plus $1.7 million from other sources.

The estimated energy cost savings will add up to $15.5 million over the 20-year useful life of the retrofits, while low-income residents benefit from a more comfortable environment.

Retrofits included the installation of building automation systems to save on space and water heating costs, and replacing aging boilers, pumps and air conditioning units.

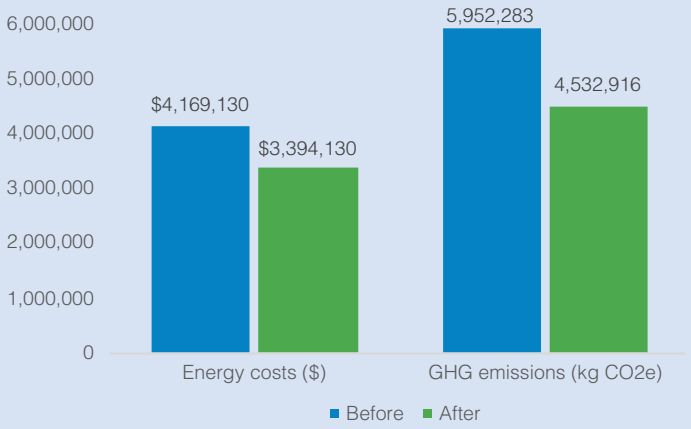


Figure 1.54. Projected annual energy and GHG savings from energy efficiency retrofits across 13 social housing apartment buildings in the City of Hamilton, funded through cap and trade revenues.

Source: City Housing Hamilton, 2017 Annual Report.

2

Part 2:
Commitment and credibility

Contents

2

2.1 Sustaining climate policy over time

Abstract

Ontario needs sustained government action on climate change. Perhaps the most promising model is the United Kingdom's *Climate Change Act 2008*. This framework sets legally binding 5-year carbon budgets 12 years in advance, based on non-partisan, expert advice on what is actually achievable. Other jurisdictions, such as New Zealand, are starting to follow suit.

Contents

Transforming Ontario's relationship with fossil fuels is a long-term challenge.

Transforming Ontario's relationship with fossil fuels is a long-term challenge that requires sustained research, training, innovation, and investment across government. All of these are difficult to develop and easily disrupted by policy changes. To attract the necessary talent and investment, Ontario needs to provide long-term clarity about its intended emission reductions and the policies it will adopt to achieve them. The benefits of such consistency could be huge, such as:

- attracting talent and businesses that want to invest in a cleaner, greener economy, and
- creating jobs in both urban and rural parts of Ontario.

It is very hard to ensure long-term consistency in a parliamentary democracy like Ontario. As actual and potential investors in Ontario have just witnessed, policies can easily be reversed with a change in government or government priorities. The resulting uncertainty is a major hindrance to the future that Ontarians need.

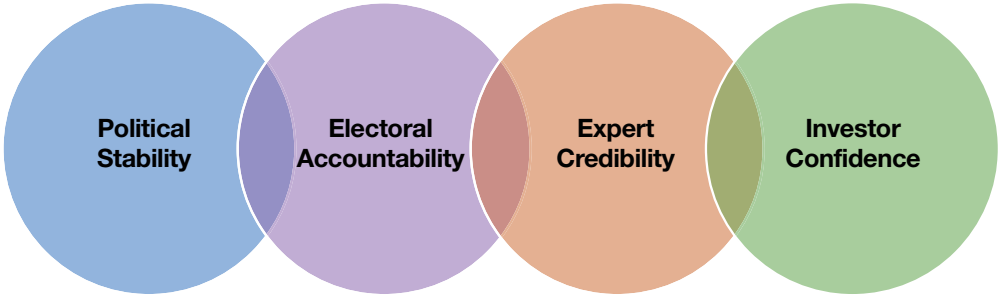
There are no legal means, in a parliamentary democracy, to *guarantee* that governments will do the hard, difficult, and perhaps unpopular work of ensuring emission reductions.

There are no legal means, in a parliamentary democracy, to *guarantee* that governments will do the hard, difficult, and perhaps unpopular work of ensuring emission reductions – no matter how much failure to act will cost later. Climate change is a difficult policy problem in democracies precisely because effective action requires today's voters to accept immediate costs and changes to their lifestyle and convenience, in order to avoid disruptions that few believe are affecting them, personally, yet. Non-democratic states, such as China, are somewhat freer to make the changes that science and economics show are necessary, but that is not a useful model for Ontario.

One of the most promising examples is the United Kingdom's *Climate Change Act.*

As the Ontario government embarks on a new approach to climate change, it can therefore benefit from the experience of other democracies that also wrestle with the challenge of ensuring climate policy stability when governments change.

One of the most promising examples is the United Kingdom's (U.K.'s) *Climate Change Act 2008*. The U.K. Parliament adopted the law with all-party support. Other jurisdictions, such as Manitoba and New Zealand, are now exploring this framework, to provide political stability, expert advice, credible emission reduction plans, electoral accountability, and investor confidence. The Manitoban government proposed Bill 16, the *Climate and Green Plan Implementation Act*, during its current legislative session.



2.1.1 Political stability

As public concern was mounting over climate change, the U.K. government commissioned the highly influential 2006 Stern Review (The Economics of Climate Change). This report demonstrated, to the government and to the public, the huge costs of climate disruption, and the significant economic benefits of moving aggressively to reduce emissions. This helped build cross-party consensus for effective reductions in emissions. In fact, all political parties began to compete to have the strongest climate change platform. The Conservatives, as official opposition, called for a climate change bill with a framework to hold the governing party to account. In response, the Labour government proposed the 2008 *Climate Change Act*, which passed with near-unanimous support in the House of Commons. This all-party consensus has allowed the *Climate Change Act* to survive changes in both governing parties and party leadership.

The *Climate Change Act* uses legally binding carbon budgets, set well in advance, to create predictable government emission reductions objectives. Carbon budgets are five-year caps on the entire economy's greenhouse gas (GHG) emissions. The act requires the government to propose consecutive 5-year carbon budgets at least 12 years in advance which, if met, will lead to compliance with the U.K.'s long-term emission reduction targets (Figure 2.1). Parliament then formally adopts the carbon budgets, which gives them as much certainty as is possible in a parliamentary democracy. Setting future carbon budgets well in advance helps insulate the process from short-term political calculations.

Setting future carbon budgets well in advance helps insulate the process from short-term political calculations.

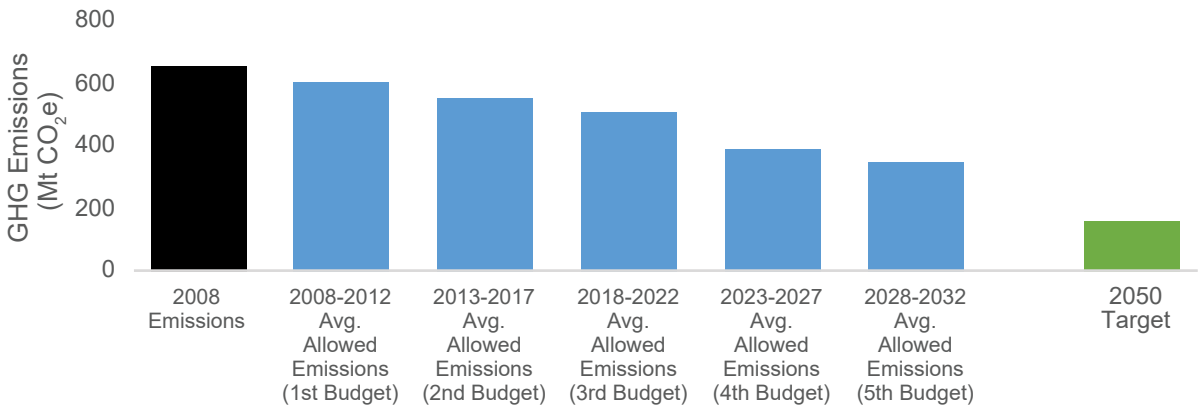


Figure 2.1. The U.K. *Climate Change Act* requires the establishment of consecutive carbon budgets for greenhouse gas (GHG) emissions (in megatonnes of carbon dioxide equivalent), set at least 12 years in advance and in line with long-term targets.

Source: Committee on Climate Change, Carbon budgets: how we monitor emissions targets (2018).

After the government legally adopts each carbon budget, it is free to use any policies it chooses to meet the budget. Different governments therefore have flexibility to pursue the budget in their own way, which has also helped the *Climate Change Act* to survive changes in government. Many policy changes have occurred, including to those supporting building efficiency, carbon capture and storage, and renewable energy.

2.1.2 Expert credibility

Before each U.K. government proposes a carbon budget, there is an independent, expert, non-partisan evidence-based study to ensure that the budget is economically and technologically reasonable. The widely respected Committee on Climate Change consists of independent experts. These experts include economists and scientists appointed for specific terms and assisted by a permanent non-partisan staff. The committee models and reports on cost-effective pathways to meet the U.K.'s long-term emission targets. These pathways form the basis of committee recommendations of realistic carbon budgets for the government to adopt.

The government is not required to adopt the committee's recommendations. But so far, the committee's credibility, combined with the long lead time for future carbon budgets, has propelled governments to adopt all five of the recommended carbon budgets, despite changes in the governing party.

The committee is also a valuable resource for research and policymaking. Its reports bring attention, and

The committee's credible, non-partisan analysis provides evidence that all parties can draw upon.

create a predictable – rather than ad-hoc – slot on the agenda of busy decision makers to focus on climate change policy. The committee's credible, non-partisan analysis provides evidence that all parties can draw upon to inform and intelligently debate policy. This has helped successive U.K. governments focus on emission reductions from coal power plants, and to a lesser extent landfills, as recommended by the committee.

2.1.3 Electoral accountability

The *Climate Change Act* makes it easier for voters to hold decision makers to account, by making it easier for voters to tell how well governments are doing at bringing emissions down. While the Committee on Climate Change provides expert advice, elected members of parliament set policy. The term of each carbon budget matches the fixed five-year term of the U.K. government. This means each term of government is accountable for a specific carbon budget, and the Committee on Climate Change reports on how well each government has complied with it. If the government fails to meet a carbon budget, it is required to explain the reason. This transparency helps hold government to account. So far, the U.K. has met the first (easy) carbon budget, and is on track to meet the second and third (Figure 2.2).

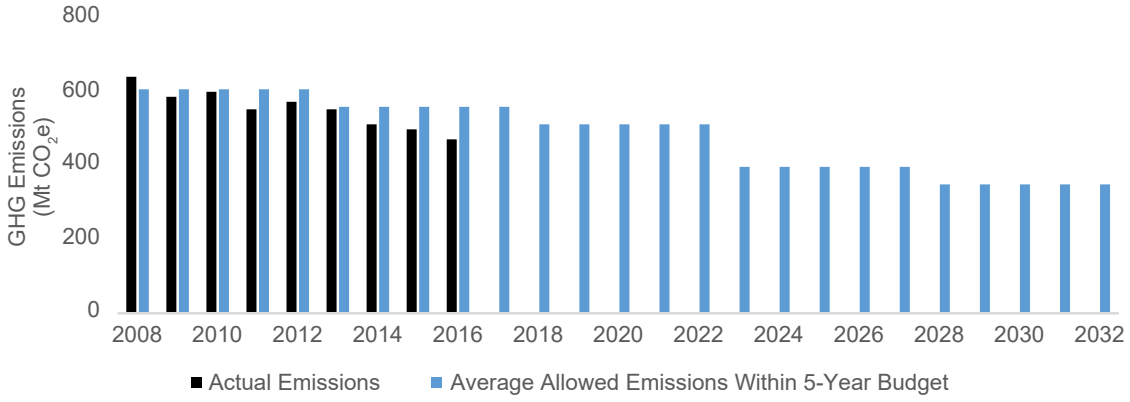


Figure 2.2. The U.K. government has met the first carbon budget, and is on track to meet the second and third budgets.

Source: Government of the United Kingdom, Final UK greenhouse gas emissions national statistics: 1990-2016 (2018).

Unfortunately, as easier emission reduction opportunities begin to give way to harder ones, U.K. political will is visibly flagging. The low-cost phase-out of coal is enough to meet the first three carbon budgets, but not the fourth, which the government approved despite internal disagreements. The Committee on Climate Change has reported current government policies will not cut emissions enough to meet the fourth and fifth carbon budgets. While the *Climate Change Act* creates a legal requirement for the government to reduce emissions, this does not prevent an unwilling government from dragging its feet or setting policies that are inadequate and ineffective.

While the Act creates a legal requirement for the government to reduce emissions, this does not prevent an unwilling government from dragging its feet.

2.1.4 Investor predictability

Would an Ontario version of the U.K. *Climate Change Act* create enough long-term clarity to give investors and talent confidence, given the inherent unpredictability of parliamentary democracies and Ontario's recent sudden policy reversals? The U.K. experience suggests it does, but only in part. While the U.K. law sends a useful long-term signal in terms of carbon targets, investment decisions ulimately depend on individual carbon policies (e.g., renewable energy incentives) and suffer when the government flip-flops.

Investors surveyed in one study understood the need for flexibility in individual government policies, but also wanted some predictability. For example, they felt the government could clarify upfront the rules of how and when, and with what notice, they might revise policies. The U.K. law does not provide this type of predictability. While investors that see business opportunities are championing stable climate change policies, the U.K. law has not neutralized the powerful opposition to emission reductions.

The Nordic approach

How else can political stability be achieved? The Nordic countries emphasize the importance of each parliamentarian accepting individual responsibility for his or her own climate leadership.

Nordic countries emphasize the importance of each parliamentarian accepting individual responsibility for his or her own climate leadership.

The Nordic Council distributes a powerful handbook for their members of parliament. It reminds parliamentarians that they are now responsible for leading their countries in fulfilling the climate promises each country has made. This complex task affects almost all the work that parliamentarians do, including economic and tax policy, annual budgets, infrastructure, land use, transportation, health, education, etc. As the handbook urges:

This is now an area of work for all parliamentarians, not only those who sit on climate or environment committees … All parliamentarians need to become climate parliamentarians.

Nordic parliamentarians also emphasize the importance of seeking common ground across party lines.

- The most important task for climate parliamentarians is to create broad public understanding of our climate challenges and what we must do about them. This requires a careful

balance between communicating the harsh reality that we must face up to, as well as the opportunities it creates.

- The second most important is to develop durable policies with broad political support, whenever possible. Governments, individuals, institutions and businesses all need to plan their energy- and climate-related investments years into the future. Payback periods of ten or more years are common. Political uncertainty (the risk of major policy changes when the government changes) damages investor confidence and can delay or derail progress. While political parties understandably, and properly, differ on specific goals and priorities, climate policies will be much more effective if investors know they will not be scrapped when the government changes.

In some countries, this responsibility for action on climate change falls mostly on national parliamentarians. But in Canada, provinces have constitutional jurisdiction over most of the laws and sectors that determine our GHG emissions. That is why it was so important that the majority of provincial premiers attended the Paris conference and supported the Canadian government in making its Paris pledge. It also means that members of the provincial parliaments now have an enormous personal responsibility for delivering Canada's international climate commitments, and for our climate future.

2.1.5 Lesson for Ontario

The U.K. *Climate Change Act 2008* is a promising model for Ontario to consider (Table 2.1). It includes the framework of carbon budgets set far in advance and a non-partisan, expert advisory committee to provide reliable advice and transparency.

It is not a panacea. Regardless of the climate consequences for ourselves, and our children, no statute will guarantee that governments take strong measures to reduce GHG emissions. But the U.K. *Climate Change Act* is the best model for a parliamentary democracy that the ECO is aware of, and Ontario should adopt something similar.

Table 2.1. Comparison between climate change legislation in the United Kingdom and Ontario.

	United Kingdom *Climate Change Act*	Bill 4, Proposed *Cap and Trade Cancellation Act*
Created with public consultation	Yes	Unknown
Created with cross-party support	Yes	No
Legally binding emission targets	Yes	No
Legally binding carbon budgets in line with electoral cycle	Yes	No
Legally required policy plan to meet carbon budgets/emission targets	Yes	No
Legally required independent, expert modelling of low cost pathways	Yes	No
Legally required third party emissions reporting	Yes	No

The ECO also recommends that Ontario adopt, as far as possible, the Nordic approach of seeking common ground across party lines, and of each parliamentarian accepting individual responsibility for his or her own climate leadership.

2

The U.K. framework on adaptation

Not only does the U.K. *Climate Change Act* address emissions reductions, it also establishes a sustained and credible approach for adapting to climate change. This includes a regular cycle of risk assessment, adaptation planning and progress reporting. This ensures that the U.K. is continually considering and planning for climate change impacts, and building on previous work and experience. In particular, the law has several requirements.

The U.K. Act establishes a sustained and credible approach for adapting to climate change.

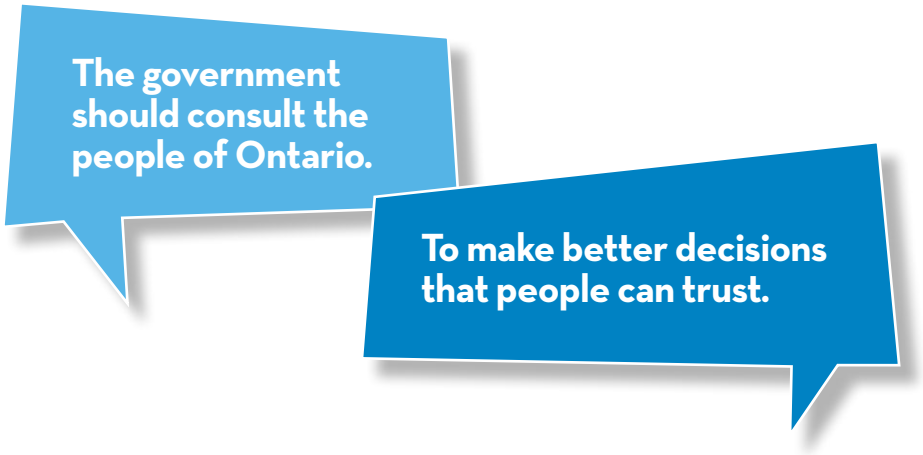
- The government must publish a U.K.-wide Climate Change Risk Assessment every five years. These assessments are informed by scientific evidence on climate change risks and opportunities, as gathered by the Committee on Climate Change's Adaptation Sub-Committee. These assessments help the U.K. government prioritize risks and opportunities where action is needed in the next five years.
- The government must produce a National Adaptation Programme every five years. It sets out the government's objectives, policies and proposals to deal with the risks, and take advantage of the opportunities, identified in the Climate Change Risk Assessment.
- The Adaptation Sub-Committee reviews and reports to parliament every two years on progress made towards implementing the programme's objectives, policies and proposals. This independent reporting requirement helps hold the government accountable for implementing the programme. The Adaptation Sub-Committee has also established a framework for evaluating the effectiveness of the National Adaptation Programme, based on a suite of indicators.
- The *Climate Change Act 2008* also allows the government to ask for adaptation reports from organizations that are responsible for essential services and infrastructure. These reports describe the current and projected impacts of climate change on organizations, and explain what they are doing to adapt to climate change. The reports can help inform future Climate Change Risk Assessments and National Adaptation Programmes. The government can also ensure that key sectors and organizations are considering climate change impacts.

2.1.6 Recommendations

To attract talent and investment, and to maximize the chance that its climate policies will be effective and will survive changes in government, the Ontario government should model its climate law on the U.K. *Climate Change Act*, including:

- statutory emission limits
- legally binding multi-year carbon budgets set 12 years in advance, which apply to the entire term of a single government
- a non-partisan, expert advisory committee with permanent staff to provide reliable advice, and to recommend carbon budgets that will meet the statutory emission limits
- regular government reports on progress towards meeting the budgets and targets, which are publicly evaluated by the advisory committee
- requiring essential service providers to prepare for climate risks.

Ontario should also adopt, as far as possible, the Nordic approach of seeking common ground across party lines, and of each parliamentarian accepting individual responsibility for his or her own climate leadership.



2

2.2 Consultation: transparency and accountability

Abstract

Ontario needs a new climate law. The government must respect its obligations and the rights of Ontarians under the *Environmental Bill of Rights, 1993* and provide real public consultation in developing its new law.

Contents

2.2.1 *Consulting on a new climate law*

Ontario needs a new, effective climate law to minimize the environmental and economic impacts of climate change on the province. The law should be developed with input from Ontarians through a robust consultation process. Once developed, it needs to be implemented as soon as possible to lessen the damage that may result from the current uncertainty about emissions reduction obligations, financial compensation, and future costs.

2.2.2 *Consultation and the* Environmental Bill of Rights

For almost 25 years, the *Environmental Bill of Rights, 1993* (*EBR*) has given all Ontarians the legal right and tools to take part in decisions on environmentally significant acts, regulations, policies, permits and other approvals under provincial jurisdiction. Under the legislation, the government has a legal obligation to consult with Ontarians on proposals that might affect the environment. Through the online Environmental Registry, environmentally significant proposals must be posted for a minimum of 30 days. During this period, Ontarians can submit comments, which the government must then review and consider before making a final decision. Ontarians also have the right to then be informed about the final decision and what effect public participation had on it.

Individual citizens have much to contribute to good environmental policy. Good public consultation through the Environmental Registry both improves the quality of government decisions and increases public acceptance of the legitimacy of those decisions.

To keep a new law on track, the government should:

- Monitor and report progress to the public at least every two years, with credible third-party validation (as in the United Kingdom model, see section 2.1), and use that information to
- Revise plans and actions as needed (with public consultation) to stay on track.

Good public consultation through the Environmental Registry both improves the quality of government decisions and increases public acceptance of the legitimacy of those decisions.

The EBR *and the withdrawal from cap and trade*

The arbitrary process used to withdraw from the cap and trade program did not comply with the government's legal obligation under the *EBR* to consult the public before making that decision.

On July 3, 2018, the cap and trade regulation (O. Reg. 144/16) was revoked by O. Reg. 386/18 (Prohibition Against the Purchase, Sale and other Dealings with Emission Allowances and Credits). This regulatory change effectively eliminated the cap and trade program, a decision that clearly has environmentally significant impacts. The government did not consult the public first, thus bypassing the clearly defined consultation process required under section 16 of the *EBR*.

Three days after the regulatory change, the Ministry of the Environment, Conservation and Parks indicated on the Environmental Registry that no *EBR* consultation was held because: "the Minister was of the opinion that the recent Ontario election was a process of public participation that was substantially equivalent to the process required under the *EBR*."

The recent Ontario election was not a lawful substitute for the process of public participation required by the *Environmental Bill of Rights*. The public's *EBR* right to participate is distinct from the democratic mandate created by elections, and was specifically created to address the erosion of public trust in environmentally significant decisions of democratically elected governments. Denying the public this opportunity to participate degrades confidence in the government's respect for the rule of law. In July 2018, the ECO wrote to the Deputy Minister of the Ministry of the Environment, Conservation and Parks raising this concern and the lack of compliance with the *EBR*.

The ECO has many reasons to believe that a lawful and respectful consultation with Ontarians, before cancelling the program, would have provided the government with essential information and feedback. The results from the consultation process might have also helped to alleviate concerns about the environmental and economic effects of the decision. In July 2018, two Ontarians submitted an application for review under the *EBR*, requesting that O. Reg. 386/18 be revoked, partly on the grounds that a proposal notice was not posted on the Environmental Registry for public notice and consultation.

The recent Ontario election was not a lawful substitute for the process of public participation required by the *Environmental Bill of Rights.*

2.2.3 Recommendations

To build good solutions that the public can support, the government must respect its obligations and the rights of Ontarians under the *EBR*, and provide real public consultation on Ontario's legislation and action plans on emission reductions and on climate adaptation.

3

Part 3:
Tools for reducing emissions

Contents

3

3.1 The least-cost pathway

Abstract

Ontario can dramatically reduce its greenhouse gas emissions at the least cost. The first steps are more energy conservation and more clean electricity. Ontario's recent policies are mostly headed in the wrong direction.

Contents

3.1.1 The question

Ontario now needs a new climate strategy – one that meets our fair share of international commitments to limit the global average temperature increase to within 1.5°C to 2°C by dramatically reducing our greenhouse gas (GHG) emissions, and that creates good clean-economy jobs and economic growth. This section asks: how can we do so at the least cost?

3.1.2 The best available tool

The best tool that the ECO could find to guide answers to this question is a high-quality model of the Ontario economy described in Appendix E. In brief, this tool uses a detailed computer model of energy use in Ontario to find the lowest-cost ways of achieving GHG reductions from Ontario's energy system, i.e., from combustion of fossil fuels for energy. Emissions from burning fossil fuels for energy make up about three-quarters of Ontario's total GHG emissions.

This tool models the lowest-cost ways of achieving GHG reductions from the burning of fossil fuels for energy.

The analysis uses the North American TIMES Energy Model (NATEM). This model is a North American version of the International Energy Agency's TIMES Energy Model, which has been used to focus public policy in nearly 70 countries, and has been progressively refined for 30 years. NATEM considers the full range of energy services in Ontario's economy, such as heating, cooling, lighting and transporting. It can model a comprehensive range of energy-related emissions reductions technologies, including information on projected costs and technical potential, calibrated for Ontario's energy sector.

The ECO retained leading expertise on NATEM to perform the analysis described in this chapter. More details on how the model works, and the results of the analysis, are provided in Appendix E.

The NATEM analysis is by no means the final word. The NATEM analysis identifies the lowest-cost ways of achieving GHG reductions in the energy sector. It does not, however, prescribe specific energy and GHG reduction policies, or deal with the difficult social and environmental issues that Ontario would face in making large-scale changes in energy supply and use, including siting new energy facilities. It also does not quantify the economic costs of the adverse impacts of climate change, or the benefits from mitigating these impacts.

As well, NATEM is only a single model, which necessarily models only certain aspects of Ontario's economy. For example, it cannot predict detailed employment impacts or co-benefits of each possible pathway. The United Kingdom Committee on Climate Change uses not one but 12 interrelated models to prepare its detailed and credible analysis of emission reduction pathways for the United Kingdom. Significant early investment in model development dramatically increased the precision and power of the committee's analyses. No such set of models is presently available to the ECO.

What the NATEM analysis does offer is a starting point for detailed analysis, which the provincial government should perform in consultation with knowledgeable stakeholders and the public. With the right input, Ontario can choose energy and GHG-reduction policies that will produce the right changes in the right sectors at the right times to minimize overall economic cost and maximize co-benefits.

With the right input, Ontario can minimize overall economic cost and maximize co-benefits.

What targets to model?

One critical input for NATEM is the emission reduction target Ontario intends to achieve. When the ECO commissioned this analysis, Ontario had emission reduction targets of:

- 37% below 1990 levels by 2030 (66 Mt reduction to approximately 113 Mt); and
- 80% below 1990 levels by 2050 (143 Mt reduction to approximately 36 Mt.)

These targets had legal force under the *Climate Change Mitigation and Low-carbon Economy Act*. The new provincial government has since proposed to revoke these targets but has not yet set new ones (although it has promised to do so), nor given any guidance how the new ones will be set. The weaker the targets and the more we delay reducing climate pollution, the more climate damage Ontario can expect and the higher the ultimate costs. As the Stern Review demonstrated more than a decade ago, the benefits of strong, early action to reduce emissions considerably outweigh the costs.

The benefits of strong, early action to reduce emissions considerably outweigh the costs.

In the absence of new official emission reduction targets for Ontario, the ECO has studied how to achieve either:

1. the 2030 and 2050 provincial targets that were legally in effect in August 2018 under the *Climate Change Mitigation and Low-carbon Economy Act*, or
2. Canada's federal targets (and Paris Agreement commitment) of 30% below 2005 levels by 2030 and 80% below 2005 levels by 2050, and what Ontario's contribution would be in a least-cost national scenario.

In particular, NATEM looks at how to reduce the three-quarters of Ontario's GHG emissions that come from the combustion of fossil fuels. The model does not provide pathways to reduce the 25% of Ontario's emissions that come from non-combustion sources (see section 3.1.4).

This section describes the results for the pathway to Ontario's emission reduction targets. Essentially the same results would apply should federal emission reduction targets be chosen instead.

Ontario's lowest-cost pathway is almost identical, no matter which reduction targets the government selects.

3.1.3 The answer

The analysis shows that:

- Ontario's lowest-cost pathway is almost identical, no matter which of the two emission reduction targets the government selects (see Appendix E for details)
- the energy sector can achieve its proportional share (i.e., three-quarters) of the emission reductions needed for stringent 2030 and 2050 targets, with existing technologies, and
- certain high-priority changes in particular sectors of Ontario's economy have the most promise to achieve the targets at the lowest possible cost.

This chapter describes the results for the pathway to Ontario's current emission reduction targets.

The pathway to 2030

Can Ontario reduce its energy sector GHG emissions to 37% below 1990 levels by 2030, using existing technologies? According to this analysis, the answer is yes, at least for the three-quarters of Ontario emissions that come from burning fossil fuels for energy. Unfortunately, Ontario's recent energy policies are mostly headed in the wrong direction.

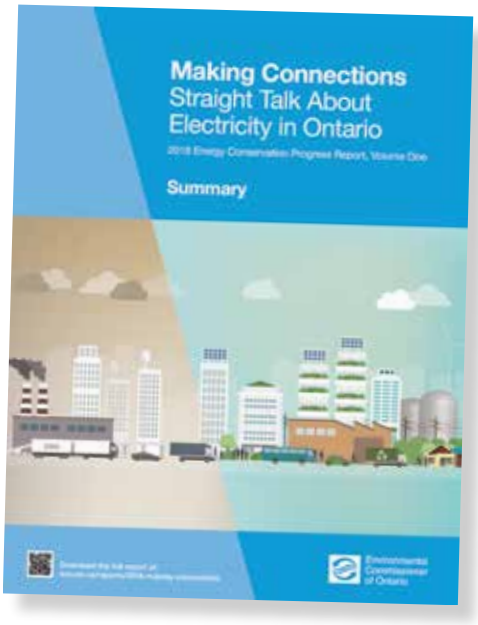
Ontario's recent energy policies are mostly headed in the wrong direction.

2030 is only 12 years from now, and much momentum has been lost by recent changes (see section 1.4). To keep total costs down, Ontario must accelerate the pace of GHG reductions and focus on the following priorities.

- Implement more aggressive energy efficiency and conservation initiatives across the economy. This is the lowest-cost way to make significant reductions quickly while saving money, creating jobs and stimulating economic growth
- Expand non-emitting renewable electricity sources, particularly hydropower (including enhanced pumped water storage), wind and solar. (More nuclear may also be cost-effective after 2030.)
  - Hydropower with storage would provide dependable electricity capacity and enable better use of intermittent renewable energy, particularly wind and solar. As the ECO discussed in Q16 of the ECO's 2018 Energy Conservation Progress Report (Making Connections: Straight Talk About Electricity in Ontario), Ontario has pumped water storage that is not currently being used to its full potential, and also has opportunities for new pumped storage projects. Other types of storage can also help integrate more wind and solar electricity.
  - Low-carbon electricity projects, including hydropower, can have significant environmental impacts that would need to be controlled, as discussed in Q10 of Making Connections.
- Expand electricity interconnections with Quebec to allow for increased clean power imports when needed.
- Enhance the uptake of electric vehicles (including buses and delivery vehicles), expand public transportation systems and improve urban planning (including urban population densification, i.e., less need for vehicular transportation) and integrate multi-modal transportation planning.
- Begin the transition to electric water and space heating in buildings.

The model estimates that, to keep the total economic cost down as much as possible, Ontario will need about 214 terawatt hours (TWh) per year of carbon-free electricity by 2030 – almost 35% more than Ontario produced in 2016, and about 40% more than planned for in 2030, as per the 2017 Long-Term Energy Plan. Some of this extra electricity demand can be met through clean power imports, but more low-carbon Ontario electricity will also be needed. The need for a large increase in low-carbon electricity supply to accommodate switching from fossil fuels to electricity reinforces the ECO's analysis in Q15 of Making Connections.

To keep the total economic cost down, Ontario will need about 214 terawatt hours (TWh) per year of carbon-free electricity by 2030.



As the ECO discussed in Making Connections, Ontario's 2017 Long-Term Energy Plan is inconsistent with achieving Ontario's emission reduction targets because it does not plan to increase Ontario's electricity capacity. The Long-Term Energy Plan contemplates electrification in parts of the transportation sector, but does not contemplate significant electrification of water and space heating, and does not plan for enough low-carbon electricity generation. The plan projects only 146 TWh of Ontario electricity production in 2030, of which 128 TWh is from low-carbon sources. Thus, the plan does not provide either the growth in electricity demand (through fuel switching) or the clean electricity supply that is needed to meet Ontario's 2030 GHG reduction target.

Ontario's lowest-cost pathway has been made harder to achieve.

Since the Long-Term Energy Plan was released in 2017, Ontario's lowest-cost pathway has been made harder to achieve by the government's cancellation of 752 green energy contracts, all of which had been counted on to supply low-carbon electricity by 2030 in the Long-Term Energy Plan. Without these projects, Ontario low-carbon electricity production will be lower, and the total economic cost of achieving emission reductions will be higher than necessary. Many energy efficiency projects were also cancelled, which could increase demand, as shown in Appendix E (see also Figure 3.1), pushing Ontario further away from the lowest cost pathway to a low-carbon economy.

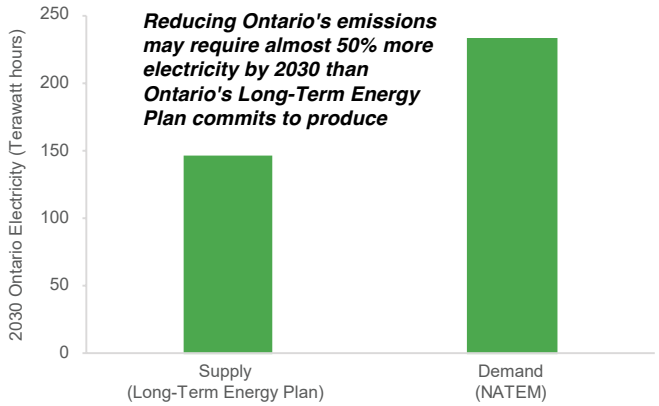


Figure 3.1. The 2030 electricity supply projected by the 2017 Long-Term Energy Plan vs. the 2030 electricity demand projected under the NATEM.

Sources: Ontario Ministry of Energy, Delivering Fairness and Choice: Ontario's Long-Term Energy Plan 2017 (Toronto: Ministry of Energy, 2017); Appendix D.

The NATEM analysis shows again why it is essential to plan Ontario's energy system as a whole, which Ontario's Long-Term Energy Plans have repeatedly failed to do. It also drives home how much energy demand Ontario must switch from fossil fuels to clean electricity, and therefore how quickly and how much Ontario's electricity supply must grow. In turn, this demonstrates that Ontario will, in a few years, need the clean, distributed electricity that was to be provided by the 752 cancelled renewable electricity projects. (Some of these projects could also have improved resilience to climate impacts by providing local sources of electricity in case of storms and accidents.)

Solar and wind technology costs have dropped over the last decade. Due to Ontario's multi-year renewable energy approval process, this sometimes led to contract prices for power that were unnecessarily high by the time projects were built. If that is the case for some of the cancelled projects, the government should explore renegotiating the price and/or delaying in-service dates to reduce the cost impact on electricity ratepayers. Such renegotiations might also help mitigate the damage to Ontario's cleantech sector and to the First Nations, public sector and business proponents of those projects.

The pathway to 2050

Can Ontario reduce its energy sector GHG emissions by 80% from 1990 levels by 2050? According to this analysis, the answer is also yes, although costs will rise significantly if only existing technologies can be used.

It should be a priority to fund innovation and research in new technologies.

Ontario's pace of GHG reductions must accelerate even faster after 2030. To keep total costs down, it should be a priority to develop and deploy new low-carbon technologies; this is one reason that cap and trade revenues were used to fund innovation and research in new technologies. However, to avoid wishful thinking, the NATEM analysis does not assume that such technologies will somehow be created. Instead, it looks squarely at what can be achieved with real, existing technologies.

On that basis, to keep total costs down, Ontario's top priorities between 2030 and 2050 must be the following.

- Transform Ontario's entire transportation system, with electricity as its primary energy source by 2050.
  - Rapid progress is being made on vehicle battery technology, with significant success in passenger and light-duty transport today. The potential exists for electricity to eventually also displace fossil fuels in heavy-freight transport. For freight, electricity would be complemented by biofuels as an important option, as well as hydrogen if it becomes less expensive.
- Transform the building sector with clean electricity, which includes heat pumps and rooftop solar systems to provide the space heating, hot water and steam that natural gas currently powers, along with a small role for biofuels. The buildings sector should be essentially fully decarbonized in Canada, and in Ontario, by 2050.
- Transform the industry sector by replacing most fossil fuel use with electricity and biofuels. Investments should also be made in heat recovery systems and industrial process changes that reduce energy demand.

To make these transformations, major new investments in the low-carbon electricity sector (possibly including new nuclear) would be needed, as Ontario's electricity demand would triple to 467 TWh by 2050. Extensive land-use changes would also be needed to help address non-combustion emissions, including afforestation, improved forest management, and the production of long-lived wood products as building materials.

Emission reduction potential and key opportunities by sector

Figure 3.2 shows the model's optimized path to meet the 2030 and 2050 GHG emissions reductions targets noted earlier for combustion (i.e., energy use) emissions. The figure outlines the emissions reductions needed from each sector, as compared with a business-as-usual reference case. Table 3.1 outlines the key mitigation opportunities that can deliver these emissions reductions at the lowest cost.

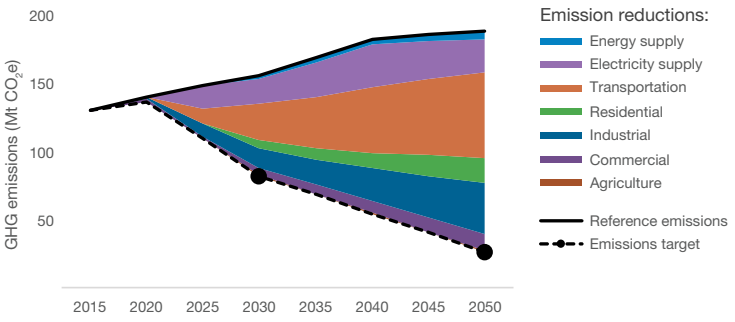


Figure 3.2. A least-cost pathway to meet Ontario's 2030 and 2050 emissions reductions targets for combustion emissions.

Table 3.1. Key mitigation actions to reduce combustion emissions (in Mt CO_2e)

	Reductions by 2030	Reductions by 2050	Key mitigation actions*
Energy supply	3	6	• Reduce fossil fuel refining alongside decreasing demand • Electrify some biofuel production processes
Electricity	19	25	• Increase non-emitting electricity generation and storage • Increase electricity imports from Quebec • Limit natural gas generation to stand-by and reserve operation
Transport	26	63	• Major electrification of ground transportation • Use biofuel for air transportation • Increase efficiency of gasoline, diesel and jet fuel use
Industrial**	15	36	• Increase electric motor use • Increase efficiency of natural gas, coal and petroleum coke use, including heat recovery • Increase use of electricity, renewable natural gas and bioenergy for heating
Residential	5	19	• Conserve energy • Increase efficiency of natural gas space and water heating • Increase use of electricity and renewable natural gas for heating • Increase rooftop solar electricity generation
Commercial	4	13	• Conserve energy • Increase efficiency of natural gas heating • Increase electric heating and motor use
Agriculture**	0	1	• Increase electric motor use • Increase bioenergy heating

Note:
* A large amount of energy efficiency and conservation is assumed to occur in the "Business as Usual" scenario, because it is already cost-effective, even without placing a value on reducing carbon emissions. However, these conservation actions will not necessarily occur without supporting programs or policies.

** Emissions from the industrial and agricultural sectors are for combustion emissions only, and do not cover all emissions from these sectors.

Figure 3.3 shows the remaining GHG emissions (combustion emissions only) by sector in 2030 and 2050, compared with 2015, if the least-cost pathway is followed. By 2050, almost all of Ontario's remaining combustion emissions would be from heating materials in the industrial sector. Some types of industrial heating may not be economically electrified because they require more intense heat than electricity can readily provide.

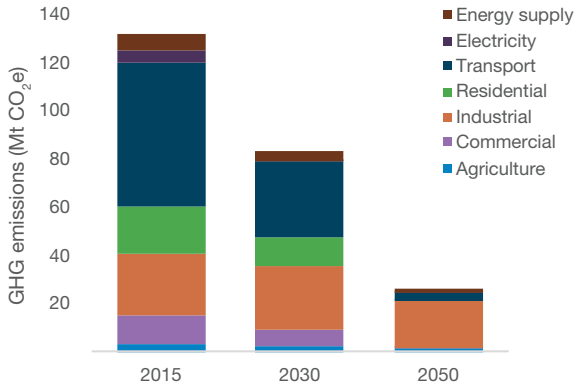


Figure 3.3. Projected Ontario greenhouse gas emissions by sector (combustion emissions only) under a least-cost pathway.

3.1.4 The harder 25%: non-combustion emissions

As the NATEM analysis shows, Ontario can reduce its GHG emissions from combustion of fossil fuels for energy to 80% below 1990 levels by 2050, using existing technologies. But that covers only the easiest three-quarters of the challenge. The other quarter of Ontario's GHG emissions are not from combustion of fossil fuels for energy; most of these come from industrial chemical and process emissions and methane emissions from agriculture and waste. Many of these emissions cannot be substantially reduced using existing technologies. In particular, available technology provides limited scope for reducing industrial process emissions, the largest share of non-combustion emissions.

The other quarter of Ontario's GHG emissions cannot be substantially reduced using existing technologies.

This is why the ECO concluded, in our 2018 Energy Conservation Progress Report, that energy use (combustion) emissions must be reduced more than their proportional share of any emission reduction targets, precisely because emissions from other sectors are likely to be harder and more expensive to reduce. Without mitigation measures or offsets, Ontario's entire 2050 carbon budget could be used up by these non-combustion emissions.

Ontario's new climate policy cannot ignore these substantial sources of emissions, and will therefore have to pursue some combination of:

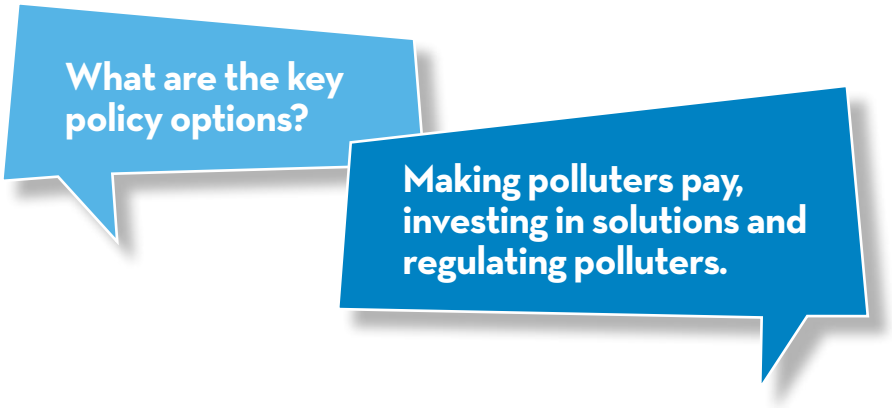
- disproportionately larger emission reductions from combustion of fossil fuels
- new emission reduction technologies, carbon capture and storage, and/or
- carbon sequestration in natural systems, such as improvements in forestry and agricultural management, accelerated tree planting, use of timber construction for buildings, and use of biomass for making chemicals.

The cancellation of cap and trade has eliminated funding for these types of projects in Ontario (see section 3.4 of this report). In addition, as the ECO demonstrated in chapter 4 of our 2017 Greenhouse Gas Progress Report, Ontario's Climate Act: From Plan to Progress, it is difficult to ensure that carbon sequestration in natural systems is real, additional, permanent and verifiable, i.e., good enough to truly offset GHG emissions that last in our atmosphere for long durations.

3.1.5 Recommendations

To minimize the cost of reducing emissions the Ontario government should:

- significantly increase Ontario's clean electricity supply, and reduce demand, by:
  - more aggressive energy efficiency and conservation across the economy
  - expanding non-emitting electricity sources (e.g., hydropower, wind, solar, nuclear) and storage (the government should therefore reconsider the 752 renewable energy contracts that it cancelled)
  - expanding electricity interconnections with Quebec to allow for increased clean power imports, and
  - enhancing the uptake of electric vehicles that are charged off-peak.
- prepare to:
  - remove most fossil fuels from transportation in Ontario
  - remove most natural gas from water and space heating in buildings, and
  - minimize fossil fuel use in Ontario industries.
- invest in new emissions reduction technologies, including carbon capture and storage, and ways to accumulate and store carbon in natural systems.



3

3.2 The three-legged stool

Having discarded the climate strategy built over the last decade, Ontario now needs a new climate strategy – one that meets our fair share of Canada's international obligations, dramatically reduces our greenhouse gas (GHG) emissions, and creates good jobs and economic growth. More generally, Ontario should be seeking to build an inclusive green economy, which the United Nations Environment Programme defines as

one that improves human well-being and builds social equity while reducing environmental risks and scarcities.

How can we maximize the benefits and minimize the costs?

As shown in section 3.1 of this report, the ECO commissioned a detailed model of energy use in Ontario, to find the lowest-cost, technically feasible ways of reducing Ontario's GHG emissions from the combustion of fossil fuels for energy. Fortunately, this analysis shows that Ontario can still achieve stringent emission reductions targets by 2030 and 2050, and outlines the lowest-cost pathway to get there. Section 3.1 and Appendix E of this report present an analysis of the technological solutions of least cost to Ontario, including the emissions reductions from each sector.

This analysis shows that Ontario can still achieve stringent emission reductions targets by 2030 and 2050.

With this knowledge, the government must then choose effective policy tools to achieve these results. There are only three major types of tools that can drive down GHG emissions from fossil fuel use as much as the

lowest-cost pathway requires. Together, they can be usefully thought of as a three-legged stool:

- making polluters pay
- investing in solutions, and
- regulating polluters.

Figure 3.4. The three-legged stool of climate policy.

Real action on reducing GHG emissions will take substantial effort, even if all three types of tools are effectively used. It will be much harder and more expensive if we give up any one of them. Each tool requires careful consideration and design to effectively reduce GHGs while growing a strong green economy. To drive down GHG emissions, the Ontario government should:

- take advantage of the power of the polluter-pay principle
- unlock funds for the low-carbon solutions that Ontario needs, and
- regulate climate pollution.

Polluter-pay programs are fair and they work.

3

3.3 Making polluters pay

Abstract

The more it costs to pollute, the less pollution there will be. This section explores various ways of pricing pollution, including Ontario's previous cap and trade program, the federal backstop, and other less comprehensive alternatives. The Ontario government's new plan to address climate change should give climate polluters financial incentives for reducing their emissions by putting a price on climate pollution, directly or indirectly.

Contents

When polluters pollute our shared water, ground or air, everyone pays. We pay through damage to the environment, human health, and infrastructure. When polluters can pollute for free, they emit more than when they have to pay.

The polluter-pay principle says that those who produce pollution should bear the costs of managing it to prevent damage to human health and the environment. It has been an internationally accepted principle since the 1992 Rio Declaration, and has been recognized as part of Canada's law by the Supreme Court of Canada.

Governments sometimes require polluters to pay a fine or a penalty following an unauthorized release of contaminants into the environment, but it is much more effective if polluters know in advance that they will have to pay for all the pollution they emit. The more they pollute, the more they have to pay. Pricing pollution gives polluting companies a clear, predictable incentive to reduce their pollution, and find solutions (see Figure 3.5). Price signals can also shift the internal culture of business.

Pricing pollution gives polluting companies a clear, predictable incentive to reduce their pollution, and they often find solutions.

The cap and trade program that Ontario had was a polluter-pay program, but there are many other possible designs. The federal carbon pricing backstop is another type of polluter-pay program.

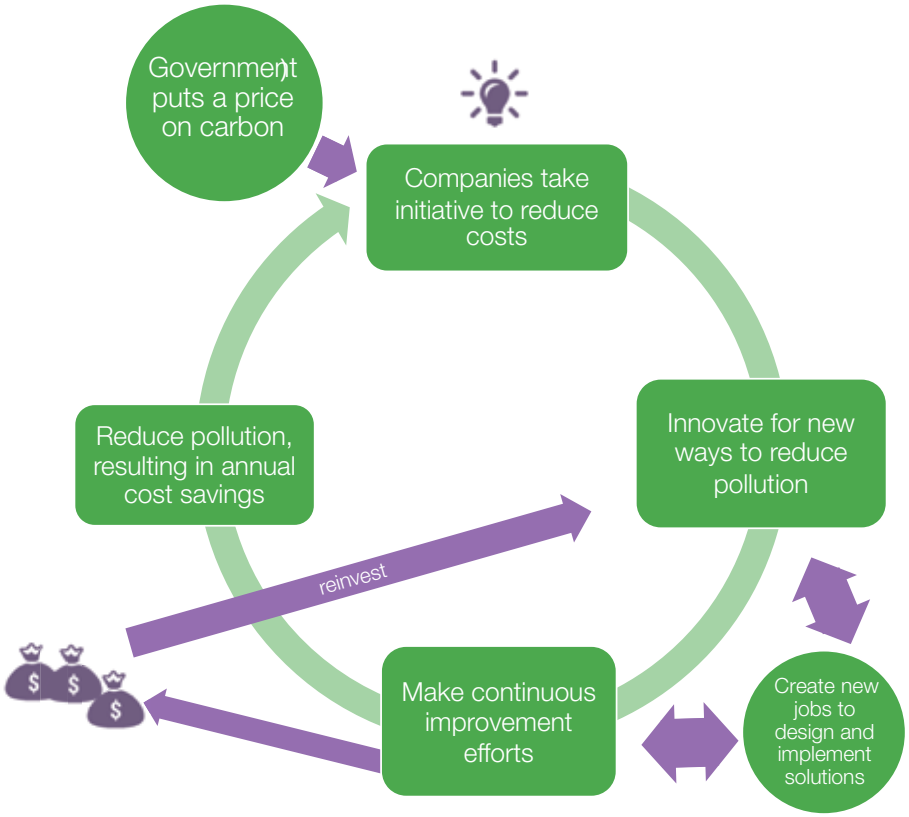


Figure 3.5. Making polluters pay can lead to innovation, creativity, and jobs.

Once pollution has a price, companies often find that reducing pollution is less expensive than they anticipated. For example, to limit the damage caused by acid rain, a cap and trade program was introduced more than two decades ago to limit sulphur dioxide (SO_2) emissions in both Canada and the U.S. Economic models predicted large and costly effects on industry. Instead, the program created an incentive for businesses to install better SO_2 scrubbers for their smokestacks, which substantially reduced the costs of compliance.

3

Pollution fees have been successfully used to address a range of environmental problems.

Pollution fees have been successfully used to address a range of environmental problems. These include limiting air pollution (e.g., particulate matter, volatile organic compounds), reducing toxins released into water (e.g., ammonia, chlorine), and discouraging the disposal of waste into landfills.

3.3.1 Economy-wide carbon pricing: a polluter-pay approach

Carbon dioxide (CO_2) and other greenhouse gas (GHG) pollution is harmful to the environment. GHG emissions contribute to global climate change and come not just from large industrial polluters. Actually, we all contribute. Every time we turn on a gas-powered car or natural gas furnace, we release GHGs into the atmosphere. The challenge is that these are everyday and sometimes unavoidable actions. This is why Ontarians need viable alternatives that allow them to reduce their contribution to climate change and move Ontario towards a lower-carbon future.

A price on carbon pollution is a key tool to move Ontario to a low-carbon economy by shifting behavior and funding solutions. There are two general ways to put an economy-wide, polluter-pay price on carbon dioxide and other GHGs: a carbon tax (which charges a fee on the production, distribution or use of fossil fuels and other sources of GHGs) or a cap and trade system (which sets a cap or limit on GHG pollution and creates a market for the trading of emissions allowances). Hybrid systems are also common. Each option has its merits and drawbacks, but both can discourage GHG emissions while generating revenues that can be spent fighting climate change. The ECO discussed and compared these carbon pricing options in our 2016 Greenhouse Gas Progress Report, Facing Climate Change.

Businesses often prefer the flexibility of an emission pricing system over other carbon-reduction tools. For example, in July 2017, when the California government was contemplating options for the state, the environmental justice movement pushed for direct regulation, while industries lobbied for cap and trade as a better solution for business. Without cap and trade, emission-reduction costs were expected to escalate, as shown in the California Air Resource Board's 2030 Scoping Plan.

Businesses often prefer the flexibility of a carbon pricing system.

Significant GHG reductions usually involve changes to processes and technologies that are only feasible through long-term capital investment. Carbon pricing incents these investments while allowing companies to innovate and control the selection of strategies that are most suitable for their businesses.

With the cancellation of cap and trade, the Ontario government has eliminated a key polluter-pay tool. As a result, the federal government has said it will apply a carbon pricing backstop in Ontario. While retaining the cap and trade program would have provided policy certainty and stability, the federal backstop can serve to provide a needed price signal for a low-carbon economy.

3.3.2 What is the federal carbon pricing backstop?

The Pan-Canadian Framework on Clean Growth and Climate Change (the Pan-Canadian Framework) requires that all provinces have a price on carbon pollution. A compliant system must either be a carbon tax or a cap and trade system, and must meet minimum requirements in terms of carbon prices and/or emission reduction targets. Ontario's cap and trade program was expected to meet the requirements set out by the federal government (see the ECO's 2017 Greenhouse Gas Progress Report, Ontario's Climate Act: From Plan to Progress, for more details). However, the Ontario government cancelled this program in July 2018 (see section 1.4 of this report).

The Pan-Canadian Framework requires that all provinces have a price on carbon pollution.

In provinces and territories that do not meet the minimum federal requirements by September 2018, the Canadian government will apply a carbon-pricing backstop through the *Greenhouse Gas Pollution Pricing Act*. The federal backstop has two parts.

1. A carbon levy (i.e., tax or fee) applied to fossil fuels; the fee will increase annually from $20/t CO_2e in 2019 to $50/t in 2022 and is payable by fuel producers or distributors early in the supply chain.
2. Measures to price pollution from industry; an output-based pricing system will apply to industrial facilities that emit above an annual threshold of 50 kt CO_2e; smaller facilities will be able to voluntarily opt in.

Part 1 is a straightforward tax applied to fossil fuels, that will be passed down the supply chain to end users, including individuals who buy gasoline or home heating fuels. It would be comparatively easy to implement and administer.

Part 2 is a much more complex plan to benchmark emissions from large industry. Companies that emit more than the benchmark will be obliged to pay for their emissions; those who emit less than the benchmark will be able to sell surplus carbon credits. By definition, this system requires the federal government to set an appropriate benchmark for each industry. Prior to the cancellation of cap and trade, benchmarks for Ontario-specific industries were not expected to be required. As such, this work may not yet be far advanced.

How does the federal backstop compare to Ontario's linked cap and trade program?

There are many differences between Ontario's former cap and trade system and the federal carbon price backstop created by the *Greenhouse Gas Pollution Pricing Act*. Many details of the federal system are still not clear, and the necessary regulations have not been adopted.

Some highlights, based on current information include:

	Ontario's former cap and trade system	**Federal carbon price backstop created by the *Greenhouse Gas Pollution Pricing Act***
Key differences	One system: majority of emitters covered directly or indirectly under cap and trade. Designed to provide predictability on the quantity of emissions reductions - market influences the price. Linked market likely to drive larger emissions reductions overall, but more reductions outside Ontario.	Two-part system: carbon levy on fossil fuels and output-based pricing system for large emitters. Designed to provide predictability on price - market determines the quantity of reductions. Emissions reductions would occur primarily in Ontario, but may be lower overall.
Type of system	The government capped the total GHGs that could be emitted, issued allowances and allowed the market (mostly public auctions) to determine the price.	A carbon levy (similar to a tax) would be applied to most fossil fuels. Large industrial emitters would be covered under an output-based pricing system (OBPS) instead, and either pay for excess emissions at the carbon levy rate or earn surplus credits, depending on their performance.
Price	About $18 per tonne in 2018. In most years, the price of Ontario allowances was expected to be less than the federal backstop. See Figure 3.6 below.	Carbon levy rate is $20/tonne in 2019; increases $10/tonne each year until $50/tonne in 2022. The price of the federal backstop has not been set for years after 2022.
Coverage	Applied to essentially all fossil fuel used in Ontario plus some industrial emissions.	Combined percentage of emissions covered under either the levy or OBPS expected to be similar to cap and trade.
Revenue use	Required by Ontario law to be used for emission reductions.	Federal government will be required by law to return revenues to the jurisdiction where they were collected, but mechanism has not been announced; may be directly to individuals and businesses in Ontario.

	Ontario's former cap and trade system	Federal carbon price backstop created by the *Greenhouse Gas Pollution Pricing Act*
Emissions reductions	The number of allowances to be made available in the Ontario system was set for every year until 2030, with reductions tied to Ontario's statutory targets (37% below 1990 in 2030, or roughly 113 Mt). The linked market allowed emissions reductions to be purchased from outside Ontario.	Quantity of emissions reductions will be determined by the market. The overall quantity of emissions reductions may be lower than under the cap and trade system in the near term – partly due to limited opportunities to purchase lower-cost emissions reductions from outside Ontario.
Large industrial emitters	"Large" emitters defined as over 25 kilotonnes/year. Large emitters received mostly free allowances, which were expected to decrease over time. Allowances could be banked or traded. Free allowances received by large industries could also be used over several years as collateral to help fund emission reducing investments.	"Large" emitters defined as over 50 kilotonnes/year. Large emitters will face a carbon price on the portion of their emissions that are above a limit, which will be determined based on industry-specific output-based standards (emissions per unit of output). Facilities that emit less than the annual limit will receive surplus credits, which can be banked or traded.
Smaller emitters	Small emitters paid on all their emissions, indirectly through their fuel suppliers. Emitters over 10 kilotonnes/year could opt to participate directly in cap and trade to receive free allowances.	Small emitters pay on all their emissions, indirectly through their fuel supplier due to the carbon levy. Emitters over 10 kilotonnes/year can opt in to the OBPS (if relevant output-based standards are available).
Size of market for trading	Allowances could be traded freely across the Ontario economy and with participants in California and Quebec.	Trading limited to large industrial emitters covered under the OBPS in federal backstop jurisdictions.
Offsets	Participants could purchase up to 8% offset credits, which would fund competitively priced emission reductions in uncapped sectors including agriculture, forestry and waste.	Credits eligible for use by large emitters only, no percentage cap. The OBPS will allow certain GHG offset credits from provincial/territorial programs. A federal offset program may be developed.
Compliance period	Fuel charges expected to be passed through to small emitters at time of sale. Multi-year compliance periods. The first compliance period was four years; others were to be three years.	Fuel charges expected to be passed through to small emitters at time of sale. Compliance period for industry expected to be annual.

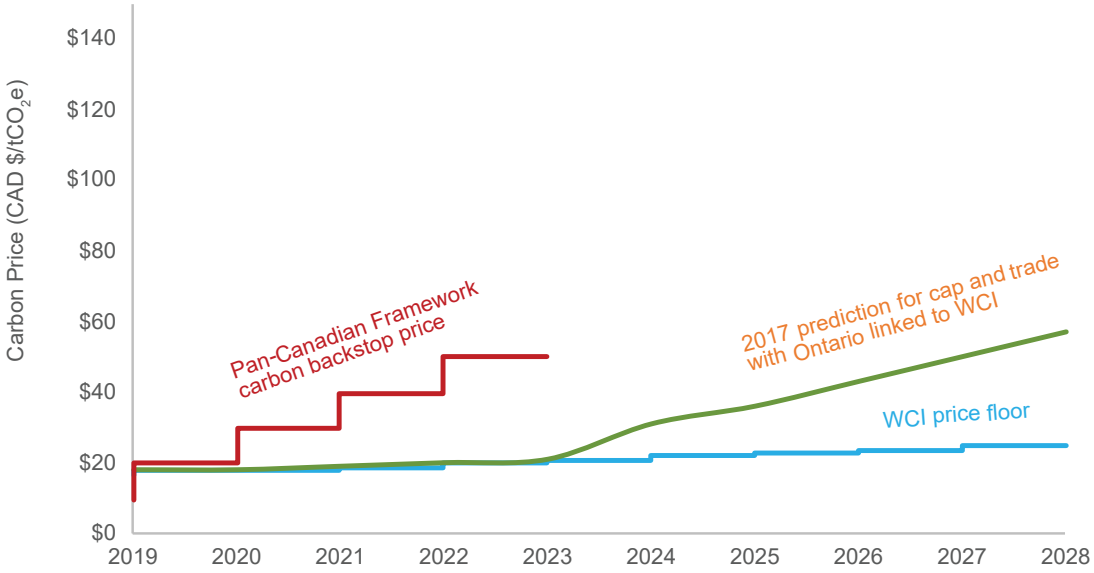


Figure 3.6. Comparison of Pan-Canadian Framework carbon backstop price compared to the predicted market price of allowances in Ontario's previous cap and trade program, which was linked to the Western Climate Initiative (WCI) with Quebec and California.

What will happen with federal backstop revenues?

Under any system where polluters must pay, revenues are generated. Under Ontario's cap and trade system, the revenues were directed towards initiatives designed to reduce greenhouse gas emissions. Under the federal backstop, the federal government has two different approaches for directing the revenues:

1. For provinces and territories that participate in the Pan-Canadian Framework, revenues will be directed to the provincial/territorial government. Provincial/territorial governments can then use the money as they wish, for example, to minimize the impact of a carbon price on vulnerable populations and sectors or to support climate change and clean growth goals. Other options include infrastructure investments and energy efficiency incentives – similar to Ontario's previous approach – and/or returning the money to residents in the form of direct payments or tax cuts.

2. For provinces and territories that do not participate in the Pan-Canadian Framework, the federal government will retain control of the revenues. Now that Ontario has cancelled its cap and trade program and has no compliant alternative in place, the federal government has indicated that none of the money will go to the provincial government, but instead will be redistributed directly to Ontarians. This could mean an annual "carbon dividend" cheque for individual Ontarians, to offset extra energy costs and build political support for climate action. Unlike income tax cuts, carbon dividends reward individuals

The federal government will retain control of the revenues.

with smaller emissions, typically leaving lower income communities better off. Some of the money could also be used to help fund much-needed infrastructure and clean energy improvements, such as the low-carbon public sector programs that the Ontario government has just cancelled.

Provinces and territories that do not participate in the Pan-Canadian Framework will no longer be eligible for other sources of funding through the framework. The federal government had previously indicated that $420 million from the Low Carbon Economy Leadership Fund would be given to Ontario for climate programs. None of that money has been dispensed, and the federal government has indicated that it is in the process of reviewing this allocation.

What is the likelihood of success of challenging the federal backstop?

Ontario's Attorney General has announced that the government would challenge the constitutionality of the federal government's carbon tax at the Ontario Court of Appeal.

Two other provinces have already publicly considered this route.

1. Manitoba considered a legal challenge and subsequently abandoned it in October 2017 after seeking independent legal advice. Manitoba's Minister of Sustainable Development stated that, "the province did not want to spend money, taxpayer resources or time on the dispute." Manitoba has since proposed its own carbon levy and output-based pricing system for large industrial emitters.

1. Saskatchewan decided to take its challenge to the Saskatchewan Court of Appeal. Several legal scholars have stated that the province is unlikely to win.

Overall, legal opinions to date suggest that Ontario is unlikely to be successful.

Now that cap and trade is gone, a federal carbon tax would restore a price on climate pollution that motivates and rewards emission reductions. The resulting funds are needed all over Ontario for GHG reduction and adaptation efforts, and could also provide a carbon dividend to families.

3.3.3 *Alternative ways to price pollution*

While the Ontario government has stopped using the most-cost-effective and comprehensive pricing tool, there are other ways to make polluters pay for certain high-carbon activities. Below are some specific examples of targeted pricing mechanisms.

There are other ways to make polluters pay.

Fuel pricing

The next best alternative to carbon pricing is a well-designed fossil fuel tax. This is because the vast majority of Ontario's carbon emissions are from fossil fuels. Thus, the primary impact of carbon pricing is higher fossil fuel prices. Like a carbon price, fuel taxes provide a financial incentive for Ontarians to reduce their use of fossil fuels, including driving less, driving more efficient vehicles, carpooling and driving in a more fuel-efficient manner. A diesel tax helps reduce emissions from freight trucking.

Unfortunately, Ontario's current gasoline and diesel fuel taxes are based on total fuel volume rather than fossil fuel content. Thus, these taxes do not encourage the use of less carbon-intensive fuel blends. For example, diesel blended with more bio-diesel produced from waste would have lower life-cycle GHG emissions, but would face the same fuel tax as diesel with less bio-diesel content. This should be corrected.

Although fuel taxes might provide a financial incentive to reduce fuel use, current fuel taxes are too low to have much impact compared to the volatility of overall fuel prices. Ontario currently has a diesel fuel tax of 14.3 cents/L and gasoline tax of 14.7 cents/L, the latter of which the government has committed to reducing by 5.7 cents/L. Reducing the gas tax is likely to increase the use of fossil fuels, which is contrary to good climate policy.

Ontario's Enhanced Gas Tax Program

Ontario multiplies the GHG benefit of the gasoline tax by dedicating 2 cents/L of that tax to improve local transit. Over 100 Ontario municipalities that provide transit receive a share of these gas tax revenues. For example, the City of Brampton used part of its share to help fund a new bus rapid transit line on Steeles Avenue. The City of Elliot Lake was able to purchase a new accessible transit vehicle. The provincial government has committed to maintaining the municipal share of these revenues, despite reducing the gas tax itself. The government should also keep the previous government's commitment to double the municipal share of gas tax revenues by the 2021-2022 fiscal year, i.e., to 4 cents/L.

Vehicle and equipment pricing

Fees for vehicles and equipment that use fossil fuels can also help reduce emissions. For example, Ontario has annual vehicle licence and registration fees. However, current Ontario annual fees of $60 to $120 per passenger vehicle are arguably negligible when it comes to influencing a purchasing decision. They should be higher and should be tied to fossil fuel consumption.

Ontario previously had a Tax for Fuel Conservation that applied to newly-purchased fuel-inefficient vehicles. The tax was scaled to fuel efficiency and increased the purchase price of gas guzzlers by up to $7,000. This helped close the purchase price gap between vehicles with fuel-efficient technologies and those without. Unfortunately, Ontario eliminated the policy in 2010; it should be restored.

The government has a powerful tool to reduce GHG emissions: well-designed road pricing.

Road pricing

The government has a powerful tool to decrease driving and thereby reduce GHG emissions: well-designed road pricing. Road pricing directly charges motorists for driving on particular roadways or in particular areas at particular times instead of charging them indirectly through taxes. Ontario currently applies road pricing to a few select highways. Most drivers avoid paying by using other roads, spilling traffic over to other highways and streets. For example, Highway 401, which does not have a fee for use, is the busiest in North America. A more comprehensive road pricing system would create a financial incentive to drive less (e.g., car pool to work, shop closer to home) or switch to active, low-carbon options such as cycling or walking.

By reducing driving, road pricing would also reduce congestion and create economic benefits for commuters and businesses. Additionally, revenues can be used to offset other financial burdens on road users that do not reduce GHGs or to fund complementary measures (e.g., transit to provide viable alternative transportation). Allowing municipalities to use road pricing would also help them access additional funds, such as federal infrastructure grants that pay for only a portion of project costs.

Road pricing could also be designed to improve air quality in heavily polluted, heavy populated areas (high-risk zones) and reduce associated health care costs. For example, low-emission zones are a form of road pricing used to strategically reduce local air pollution in more than 250 cities and towns across Europe. In high-risk zones, old, heavy-duty diesel freight trucks are charged to enter the area. Some of these cities also charge older, higher emission passenger vehicles and dedicate revenues to transportation system improvements. Road pricing based on vehicle age, class and location in Ontario could strategically target high-risk areas and raise revenue from vehicles that were designed to meet older, less stringent federal air pollutant and GHG emission regulations. See section 3.5 for regulations that can cut health care costs by reducing emissions from high-polluting vehicles.

For more discussion of road pricing, see our 2017 Greenhouse Gas Progress Report, Ontario's Climate Act: From Plan to Progress.

Feebate

Another way to charge for GHG pollution without creating a tax is to use a combination of fees and rebates – a revenue-neutral feebate. A partial precedent exists; some of the revenue from Ontario's vehicle fees were used to fund rebates of up to $2,000 for the purchase of fuel-efficient and alternative-fuel vehicles. A revenue-neutral program is discussed in section 3.6.

This type of system could also be used to encourage the purchase of high-efficiency options for other equipment and products, such as home furnaces, heat pumps, and air conditioners. Several existing electricity and natural gas conservation programs provide small incentives for energy-efficient equipment, but so far, it is rare to apply a fee to inefficient equipment that result in higher levels of carbon pollution.

Polluter-pay pricing can discourage the release of high global warming potential (GWP) pollutants.

Fees on high global warming potential pollutants

Aside from fossil fuels, polluter-pay pricing can discourage the release of high global warming potential (GWP) pollutants, some of which can have a climate impact up to 23,000 times more than carbon dioxide. They include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and other chemicals like anaesthetic gases. These pollutants come from a wide range of manufacturing plants and products including:

- air conditioners (in automobiles, homes, and buildings)
- refrigerators
- fire extinguishers
- propellants in consumer aerosol products, like aerosol paint, personal care products, and air horns
- spray foam insulation and other foams
- electric power transmission equipment
- cleaning solvents, and
- anaesthetics.

To discourage the leaking or release of these potent pollutants into the environment, the government should apply a surcharge at time of purchase for any product that results in the release of these pollutants. The intent would be to encourage industry to use alternatives that have lower climate impacts.

While not as potent as HFCs, methane (CH_4) and soot cause rapid climate damage. A similar polluter-pay principle could be applied to emissions of unburned methane, which is often released through accidental leaks or venting during the production, transportation and use of natural gas, and of soot from diesel vehicles, which can easily be controlled with filters.

3.3.4 Conclusions and recommendations

The Ontario government needs a new plan to address climate change. Making polluters pay and putting a price on carbon are effective ways to reduce pollution. A pricing approach could be combined with regulations and incentives to help Ontario move forward with combatting climate change. In the absence of cap and trade, the federal backstop can provide a necessary, economy-wide price signal.

As discussed above, there are many polluter-pay approaches the Ontario provincial government might adopt. The best would be an economy-wide price on GHG pollution, designed to meet the requirements of the Pan-Canadian Framework. In the absence of such a price, targeted taxes, fees and road pricing should give climate polluters meaningful incentives and rewards for reducing their GHG emissions.

3

3.4 Finding ways to pay for solutions

Abstract

The second key element of effective government policy to reduce greenhouse gas pollution is finding ways to pay for solutions.

Ontario needs substantial investments across the economy in low-carbon technologies and infrastructure so that Ontarians have adequate options to reduce their emissions. Public sector buildings alone, including public housing, schools, and hospitals, have huge unmet needs for capital upgrades to reduce their fossil fuel consumption.

Ontario collected $2.87 billion from climate polluters through cap and trade and used the money to fund a large number of emission-reducing initiatives. While there was some duplication and a small number of initiatives did not meet the minimum legal requirements, most of these programs were on the way to producing economic and environmental benefits for Ontarians. Initiatives that had funding withdrawn after the June 2018 election included energy efficiency retrofits for social housing, schools and hospitals; municipal transit, waste and cycling projects; and industrial research and innovation. The financial support available through these programs triggered interest, initiative and innovation across Ontario, suggesting that a lot can be accomplished with $2 billion year.

Without revenues from cap and trade, Ontario must find other substantial sources of funds to invest in low-carbon solutions. Such funds could come from a mix of public and private sources.

3

Contents

3.4.1 Introduction

The second key element of an effective climate strategy is finding ways to pay for solutions.

Ontario had a stable source of funding for climate solutions of around $2 billion per year until cap and trade was cancelled in June 2018. This money was raised from carbon polluters, and was used to fund a range of programs to cut emissions and support innovation in Ontario – these are summarized in Appendix B.

3

This report does not revisit the important questions of which programs are the most effective use of funding, and what proportion of carbon revenues should be returned to citizens or used to reduce taxes. Instead, we focus on how, having given up the revenues from cap and trade, is Ontario to fund the substantial investments necessary for its climate strategy?

How, having given up the revenues from cap and trade, is Ontario to fund the substantial investments necessary for its climate strategy?

Ontario will need to invest billions of dollars between now and 2030 to reduce emissions in line with Canada's international commitment – which is itself very weak. These investments are needed across the economy – in public and private buildings, in business and industrial innovation, in public and active transportation, in expanding and improving our clean electricity grid, etc.

Financing this investment will be a challenge that the public and private sectors must work on collaboratively. Government cannot – and should not – be responsible for it all, but it does have a critical role to play in enabling the private sector to step up to the table.

This section outlines:

- the potential funding sources to finance climate solutions in Ontario
- some of the barriers and solutions to unlocking finance from the private sector, and
- key next steps the government can take to begin to fill the financing gap left by the loss of cap and trade.

3.4.2 Public funding sources

Without cap and trade revenues, Ontario will need to look elsewhere for climate change funding. Could some of the money come from public sources, without adding to Ontario's fiscal deficit, while stimulating private investment and cleantech growth in the province?

Using the remaining cap and trade revenues

Ontario's cap and trade program raised $2.9 billion in its first 18 months. This money came mostly from climate polluters, and was used to invest in activities to reduce emissions across multiple sectors. See Appendix B for a summary of the 50 Greenhouse Gas Reduction Account (GGRA) programs funded, and progress to date.

About $1 billion of this money was unspent by March 31, 2018 (35% of the total). Under Bill 4, the proposed *Cap and Trade Cancellation Act, 2018*, this money can be used to cover wind down costs for cap and trade and related programs (e.g., the Green Ontario Fund),

At a minimum, the GGRA funds should not be diverted to purposes other than reducing emissions.

as well as administrative expenses and compensation for cap and trade participants. Bill 4 also allows the government to spend remaining revenues on existing GGRA initiatives. The government has stated that it will review these initiatives on a case-by-case basis before it decides whether to continue funding them. Many of them should receive continued funding. At a minimum, the GGRA funds should not be diverted to purposes other than reducing emissions.

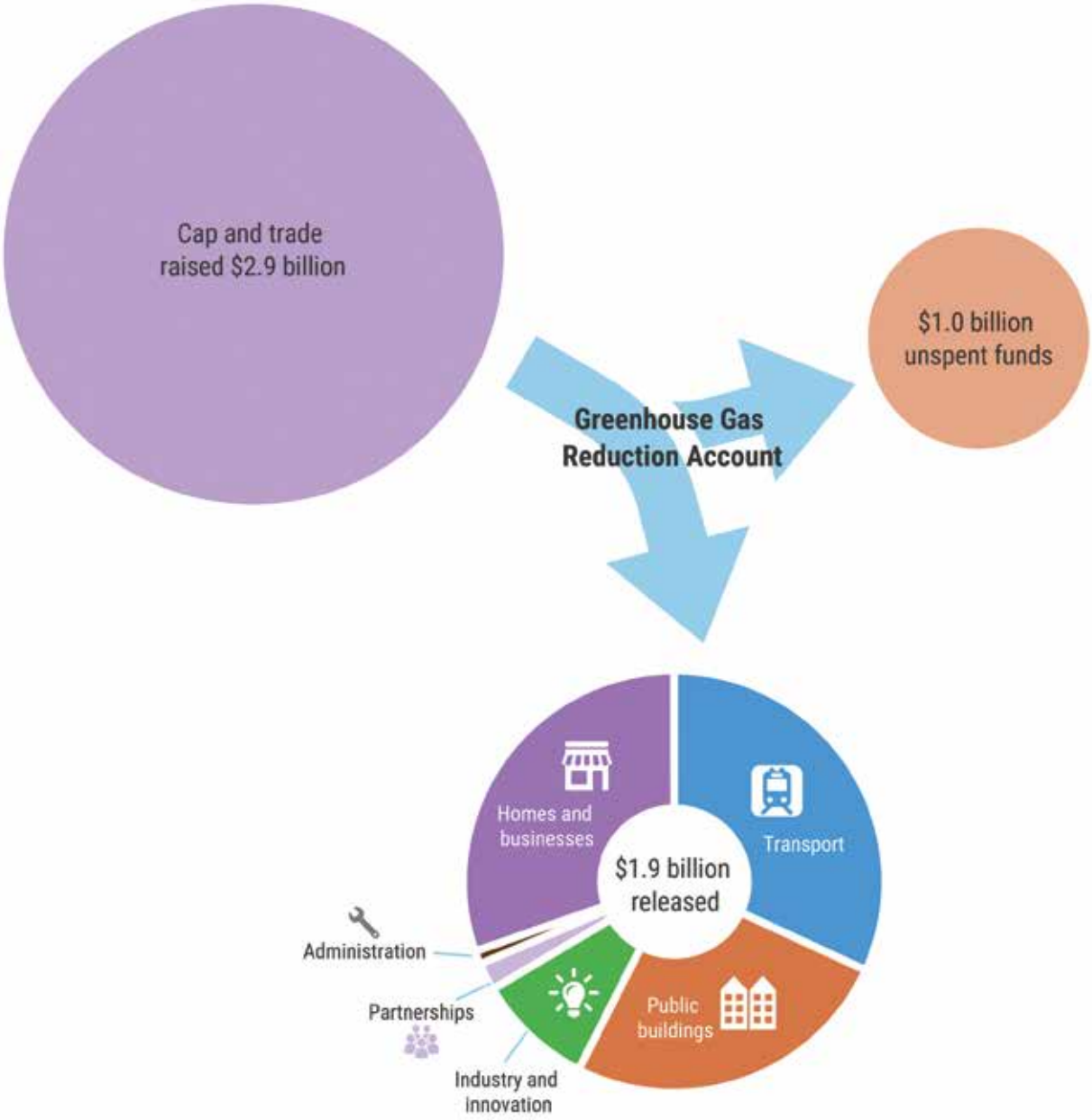


Figure 3.7. Cap and trade raised $2.9 billion for a range of low-carbon initiatives.

Federal funds

The federal government has made a commitment to provide funding to provinces and territories that have signed on to the Pan-Canadian Framework. The $1.4-billion Low Carbon Economy Leadership Fund will support emission reduction efforts by provinces and territories. Ontario was allocated $420 million, including $100 million which the previous provincial government allocated to home energy efficiency retrofits under the recently cancelled GreenON program. The federal government is currently reviewing this allocation.

The second potential source of funding for the province is the federal carbon tax, which is slated to come into effect January 1, 2019. The tax will start at a $20/tonne price (slightly above the approximate $19/tonne at Ontario's last cap and trade auction) and rise by $10 each year to $50/tonne in 2022. The details of the federal plan, including how it applies to industrial emissions, are still being worked out, but it seems likely that over the next four years the proceeds would be higher than the revenues from cap and trade.

The provincial government could receive these funds if it co-operates with the federal government in levying the tax. The federal government has stated that, if the provincial government does not co-operate, the federal government would disburse the funds itself, perhaps to individual Ontarians in the form of a carbon dividend (see section 3.3 for more discussion on the Pan-Canadian Framework and carbon pricing).

Ottawa's O-Train light rail transit (LRT) crossing the Rideau River. The Stage 2 extension is one of the projects jointly funded by federal and provincial infrastructure funds.

Photo credit: Lezumbalaberenjena.

A third source of federal funding is the $11.8 billion for infrastructure over 10 years that was announced in March 2018. This includes $8.3 billion for public transit and $2.8 billion for green infrastructure projects that support GHG reductions and help the province adapt to climate change. The previous Ontario government promised to match this with $9.6 billion in cost share funding.

Low-carbon procurement

Low-carbon government procurement could reduce emissions and save money over the working life of government assets. As the largest single buyer in the Ontario economy the public sector can also drive innovation and deployment of Ontario-made clean technologies and spur continued economic growth in this key sector.

Examples of low-carbon procurement (clockwise from top left): Recycled aggregate; the University of Waterloo; hybrid Ontario Public Service vehicle.

Photo credits: Andrew Snook, Rock to Road Magazine; LEED Platinum - Environment 3 at University of Waterloo; Queen's Printer for Ontario.

Low-carbon procurement policies in other countries have reduced costs and GHGs.

The provincial government spends about $1.9 billion each year on goods and services, and had committed to invest $190 billion over 13 years on infrastructure. Low-carbon procurement policies in other countries have reduced costs and GHGs. In seven European countries, green procurement helped to cut costs by 1%, and reduce emissions by 25%.

In Ontario, the public sector emits about 6.5 million tonnes of GHGs annually from hospitals, schools, and other public buildings and assets, and spends heavily on energy. Low-carbon procurement policies could improve the efficiency of government spending, cut energy costs in public buildings, and show that Ontario supports innovation and low-carbon businesses while cutting GHG emissions.

As well, the government can use public procurement to reduce operating costs and improve public health through low-carbon transportation. For example, based on a commitment to add low-emission (electric or hybrid) vehicles to its fleet wherever possible, the Ontario Public Service (OPS) added 1,400 new low-emission vehicles between 2006 and 2016 and these now represent more than one in four OPS vehicles.

Procurement policies can also be used to support Ontario cleantech companies through the "valley of death" (see Figure 3.8) and send a broader market signal to other potential buyers. For example, before its cap and trade funding was withdrawn, Ontario's Green Focus on Innovation and Technology (GreenFIT) public procurement program intended to demonstrate made-in-Ontario clean technologies at hospitals, universities and other public sector buildings. By adopting low-carbon procurement policies, the government can provide a platform for small or growing companies to demonstrate and validate their products or services to a wider market. Such programs require long term, patient capital and support and are thus well suited to government.

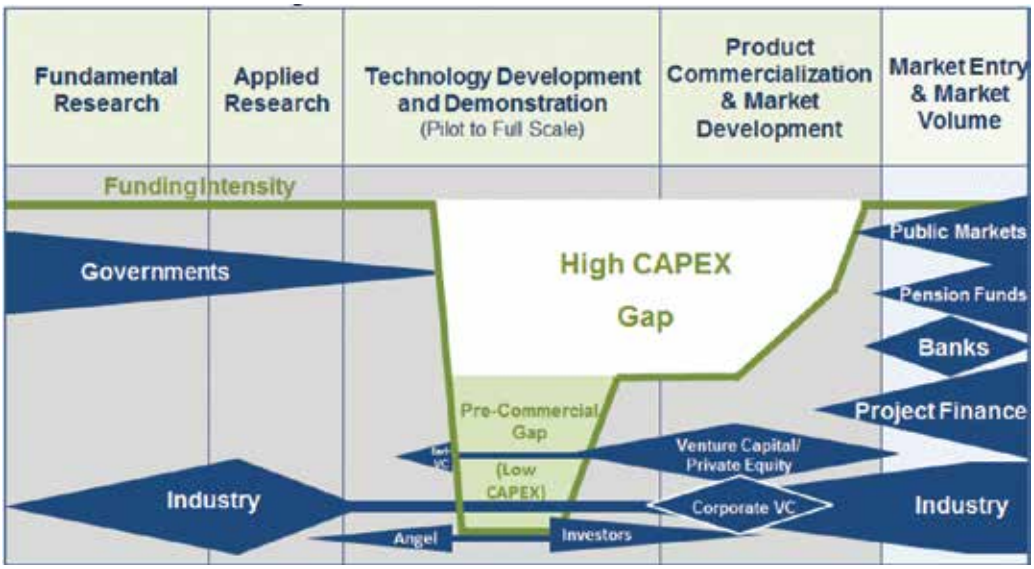


Figure 3.8. The cleantech "valley of death."

Note: Ontario is home to one of the largest and most innovative cleantech sectors in the world. Cleantech companies still face significant barriers to growth, including the funding gap between early stage research and development, and market entry. This stage is known as the "valley of death" because so many companies do not survive it. Government support can provide needed capital to help demonstrate and validate early stage clean technologies, and stimulate local demand and private investment.

Source: Vicky Sharpe, Corporate Director and Founding President & CEO, Sustainable Development Technology Canada (SDTC).

Electric ferries in Ontario

In March 2018, the Ontario government announced it would be procuring new electric ferries to service Amherst and Wolfe Islands. These are planned to be running by 2020 and 2021. These measures are not just good for the environment and public health; they save money for the government too. Norway put the world's first electric ferry into operation in 2015 and has since cut costs by 80% and GHG emissions 95%. It now plans to procure another 60 electric ferries by 2021, and phase out diesel ferries across its fleet by 2023.

Photo credit: Sverre Hjørnevik

Leveling the playing field by cancelling fossil fuel subsidies

...we commit to rationalize and phase out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption. As we do that, we recognize the importance of providing those in need with essential energy services... This reform will not apply to our support for clean energy, renewables, and technologies that dramatically reduce greenhouse gas emissions.

G20 Leaders Statement: The Pittsburgh Summit, September 2009

One reason private investment is not flowing towards low-carbon, clean energy technologies at the scale needed is that fossil fuel subsidies tilt the playing field towards carbon-intensive alternatives. Each year, Ontario provides about $625 million in fossil fuel tax breaks (i.e., subsidies). The government also subsidizes the expansion of fossil fuel infrastructure; e.g., a $100 million grant for natural gas pipeline expansions that would otherwise be uneconomic. Although relatively small by comparison to Canada's overall fossil fuel subsidies (estimated at $3.3 billion per year), Ontario's subsidies distort the market and reduce available funding for cleaner sources of energy.

Canada and Ontario's commitment to phasing out fossil fuel subsidies

International energy and economic experts such as the G20, International Energy Agency, International Monetary Fund, Organization for Economic Co-operation and Development, and Asia-Pacific Economic Cooperation forum, have all called for phasing out inefficient fossil fuel subsidies. Canada has made three formal international commitments to do so, although progress towards this goal has been slow; the federal government has also promised targeted support for low-income Canadians. While Ontario committed to "reform existing policies and programs that support fossil fuel use and fossil fuel-intensive technologies," there has been little change in provincial fossil fuel subsidies since the ECO reported on this in 2016.

These subsidies are an inefficient use of public funds that support mature, polluting technologies over innovative clean energy, in most cases encouraging higher fossil fuel use and emissions while discouraging energy conservation. Their impact is directly contrary to efforts to reduce GHG emissions and fight climate change and, in the form of tax breaks, they represent foregone revenue that could otherwise be invested in emission reductions.

This is not to say that all fossil fuel subsidies should be eliminated without notice or consultation. While fossil fuel subsidy reform is urgent for environmental and climate reasons, the impacts of reform on vulnerable segments of society must be carefully managed. While subsidies often benefit richer families disproportionately, higher energy prices have a serious effect on poorer households, for whom energy often represents a large share of total spending. The impact on businesses can also be significant, depending on timing, on offsetting supports, and on their opportunities to moderate fossil fuel consumption by shifting to cleaner options.

Nevertheless, there are much better uses for the money that Ontario now spends year after year subsidizing fossil fuels.

Phasing out damaging fossil fuel subsidies would generate hundreds of millions of public dollars that can be reinvested in cleaner alternatives and innovation, while also providing transition support for poorer households and vulnerable sectors (see text box below). Importantly, it would provide a level playing field for investors looking to support low-carbon energy and infrastructure projects.

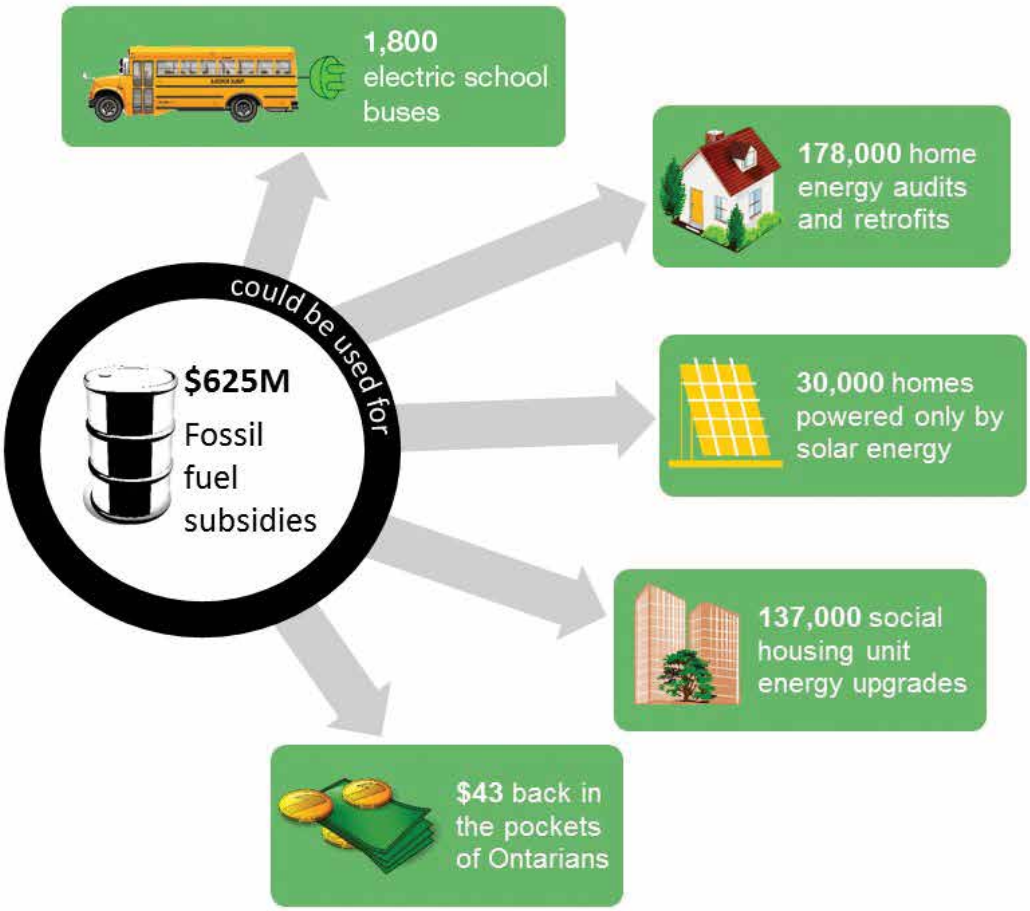


Figure 3.9. Ontario's fossil fuel subsidies are worth $625 million each year in tax breaks. There are many other uses that would bring low-carbon and/or social benefits. Some examples of how $625 million could be spent are highlighted here.

Source: Ontario Ministry of Finance, Transparency in Taxation (2017); Ontario Ministry of the Environment, Conservation and Parks, Climate Change Action Plan Annual Report (2017); Union Gas; Ontario Solar Installers.

Alternatives to fossil fuel subsidies

One of the larger subsidies is for heating oil used to heat residential buildings, which in 2017 accounted for $107 million in foregone revenue ($19 million more than in 2015). A better use of this money would be an energy audit and retrofit program specifically for oil-heated homes. This would allow homeowners and tenants (typically rural and often lower-income) to permanently reduce their energy bills and greenhouse gas emissions, thus reducing the need for an ongoing subsidy.

For marine and other off-road transportation businesses, the existing subsidies could be redirected to support the acquisition of high-efficiency, low-emission engines and other equipment. For environmentally responsible forms of agriculture, forestry and construction, existing subsidies should be redirected to support the ecological and climate-regulating ecosystem services they provide. For example, the $34 million in fossil fuel subsidies that farmers received in 2017 would be far better spent to support climate resilient priorities such as improving soil health.

A better use of this money would be an energy audit and retrofit program specifically for oil-heated homes.

The government could also redirect a portion (e.g., $100 million) of the money now lost to subsidies to capitalize a clean technology innovation fund to support Ontario entrepreneurs and companies to demonstrate and scale up new ideas. This could build on the projects initiated under the Target GHG program, administered by Ontario Centres of Excellence, as well as the Low-Carbon Innovation Fund and Centre for Social Innovation's Agents of Change incubator program.

Photo credit: Chris Brown.

Table 3.2. Summary of public sector low-carbon funding sources.

Source	Total potential amount	Potential uses
Cap and trade remaining revenues	Up to $1 billion	Wind down costs Compensation costs Continue effective GGRA programs
Federal carbon tax	More than $2 billion per year	Projects to reduce emissions Carbon dividend
Federal Low Carbon Economy Fund	$0.4 billion	Projects to reduce emissions
Federal green infrastructure funding	$11.8 billion over 10 years (+ Ontario commitment of $9.6 billion)	Public transit and low-carbon infrastructure
Public procurement budget	$1.9 billion annually	Low-carbon goods and services Cleantech innovation
Fossil fuel subsidies	$0.6 billion annually	Clean energy Targeted support for vulnerable Ontarians Cleantech fund
TOTAL	**~$8 billion annually**	

3.4.3 Expanding utility energy conservation programs

Energy use in buildings and industry accounts for nearly 40% of Ontario's GHG emissions. While industrial GHG emissions are falling, emissions from buildings are growing faster than every other source except transportation. The majority of these emissions come from natural gas used for space and water heating. The provincial government has now cancelled $1.5 billion in programs that were set up to reduce energy use in homes, hospitals, schools, businesses and industry.

Energy efficiency improvements have large economic and job benefits.

Energy efficiency improvements have large economic and job benefits (see section 1.5), although the upfront costs can be high and payback can take many years. Therefore, the government needs to find some means of incenting and financing efficiency improvements. One option is by expanding existing utility-run energy conservation programs.

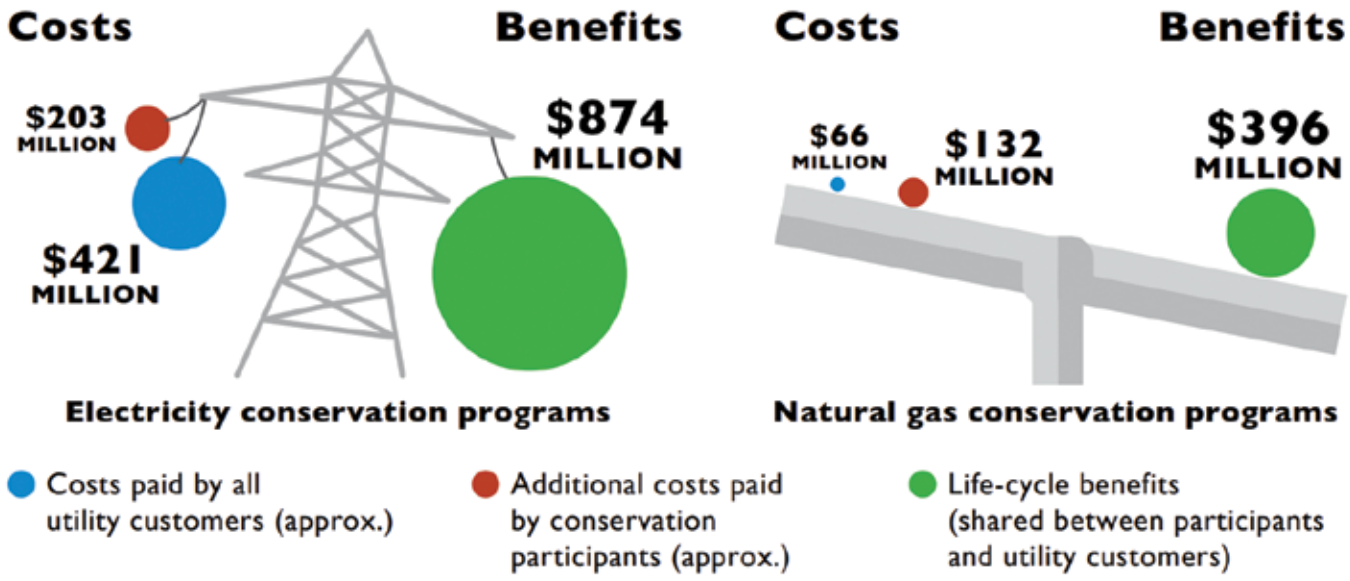


Figure 3.10. The costs and benefits to society of Ontario's energy conservation programs in 2014.

Source: The ECO's 2015/2016 Energy Conservation Progress Report, Conservation: Let's Get Serious, p. 126.

These programs are financed by ratepayers through their natural gas and electricity bills. They provide incentives for homeowners and businesses to adopt energy-saving technologies and behaviours. Since the 1990s, they have driven energy and cost savings with a good return on investment – for every $1 invested, electricity conservation saves $2.25 (2016) and natural gas conservation saves $2.50 (2015).

The Ontario Energy Board recently expanded the utilities' permissible budget for natural gas conservation programs to around $135 million per year, although utilities' spending has yet to catch up with this. Even after this expansion, natural gas conservation programs still receive only around one-third of the funding that electricity conservation programs do.

A further expansion of natural gas conservation programs could reap significant benefits – by 2030, Ontarians could cut their natural gas use by as much as 18% (5 billion m^3/year), with the fuel cost savings greatly exceeding the increased spending on conservation technologies, according to the Ontario Energy Board. This saving is equivalent to an annual GHG reduction of 9.3 million tonnes of CO_2e/year. This would require a four- or five-fold expansion of program budgets, which could be financed through careful adjustments to utility bills, while minimizing harmful impacts to Ontarians struggling with high energy costs.

The government should also take advantage of all cost effective electricity conservation, especially conservation focused on times of highest demand. Peak demand is what drives the need for costly new electricity infrastructure. By maximizing Ontario's available low-carbon electricity through conservation measures, Ontarians will have a more affordable source of low-carbon energy available for the necessary transition away from fossil fuels.

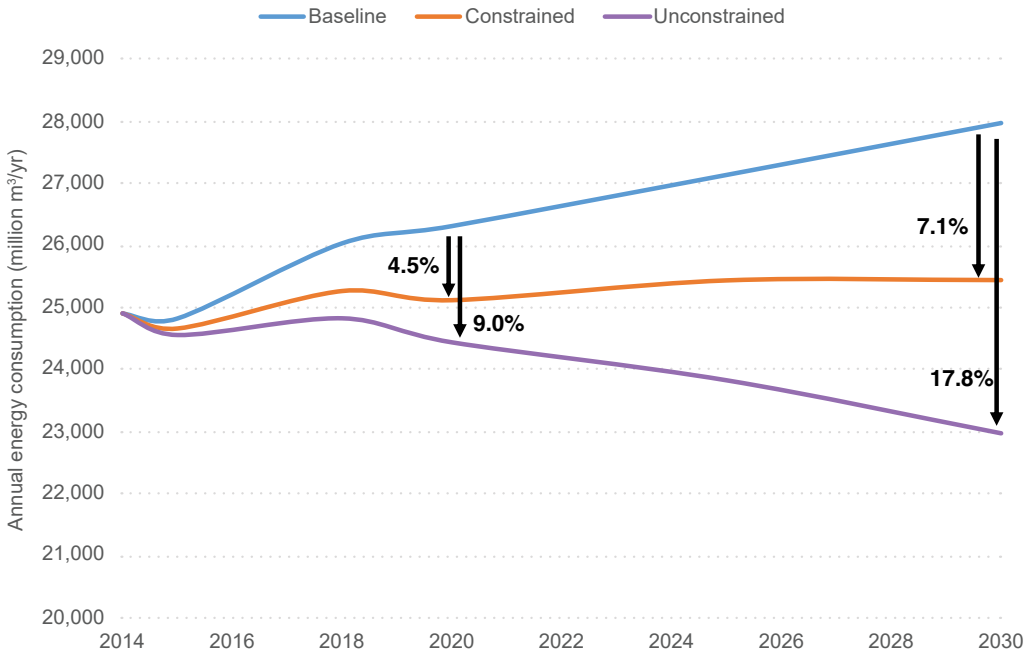


Figure 3.11. Natural gas savings under conservation budget scenarios in 2020 and 2030, compared to baseline energy consumption. Constrained assumes $111 million/year to 2020 and $120 million/year to 2030, and unconstrained assumes $550 million/year to 2020 and $722 million/year to 2030.

Source: ICF International, Natural Gas Conservation Potential Study (OEB: 2016).

3.4.4 *Catalyzing private investment in climate solutions*

The world needs $53 trillion of energy investment by 2035 to avoid dangerous climate change and investors need policy certainty to help deliver this. Delaying strong policy on climate change would be a false economy.

Philippe Desfossés, CEO of French public pension fund ERAFP.

The private sector must also play a key role in financing solutions to climate change.

Global private investment in clean energy and efficiency has skyrocketed over the last decade to $280 billion per year – a 500% increase. This market shift has

Figure 3.12. Ontario's cleantech sector by the numbers.

Source: Invest in Ontario, www.investinontario.com/cleantech

in part been driven by rapidly dropping renewables prices, huge public investments from China and other countries, and a shift in investor priorities and confidence away from fossil fuels.

Improving energy efficiency in Ontario's buildings alone represents a multi-billion-dollar opportunity.

The economic opportunity for Ontario is clear. Improving energy efficiency in Ontario's buildings alone represents a multi-billion-dollar opportunity. Ontario is also home to a $36-billion cleantech and renewable energy industry representing the largest concentration of cleantech capital in the world, and employing 65,000 people (see section 1.5).

Large investors – such as Ontario's public sector pension funds, which control over $400 billion in assets (see case study below) – are increasingly taking action to disclose climate risk and shift investments into cleaner solutions. And many private companies are taking voluntary action to cut their GHG emissions, with benefits to their bottom line and competitiveness (e.g., Green Economy Canada has a network of 260 small businesses across Ontario setting targets and taking actions to reduce emissions).

However, Ontario's capital markets and private investors still face a number of challenges in taking advantage of this opportunity, and as a result most private capital remains invested in carbon-intensive or conventional projects and industries. This is a missed opportunity; for example, only a fraction of the energy efficiency improvements in buildings is currently privately financed, despite attractive double-digit investment returns and social and environmental co-benefits.

While it does not need to do all the heavy lifting, Ontario's government does have a critical role to play in helping to address these barriers – through setting clear direction and policies, leveling the playing field, and de-risking private investments, among other actions.

Barriers and solutions to low-carbon investments

A number of barriers prevent greater private investment in low-carbon solutions in Ontario. Some of these are general and others specific to certain sectors or industries.

We explore some of these barriers – and how the government can address them – in more detail below. We also take a closer look at one pool of money – public sector pension funds – with both the capacity and motivation to invest in the low-carbon economy.

3

Policy uncertainty

It is critically important that the regulatory framework be independent and stable. You can't invest $2-3 billion into a country only to find that every four years the rules have changed.

Ron Mock, President and CEO of Ontario Teachers' Pension Plan, speaking at the Canadian Club Toronto Pensions Panel, February 29, 2016.

Low-carbon projects in Ontario, such as renewable energy, had difficulty attracting private investment even before June 2018. However, the abrupt cancellation of cap and trade (including the value of almost $4 billion worth of carbon allowances and GHG reduction contracts) and the termination of 752 clean energy contracts may make such projects even less attractive for investors in the future.

Businesses and other impacted organizations have described numerous concerns to the ECO, including lack of notice, lack of consultation, cancellation of contracts negotiated in good faith over many years, talent and money invested, and uncertainty about compensation for their resulting losses.

The government's new climate change plan should offer a clear long-term vision for energy and infrastructure investments needed to reduce Ontario's emissions, to restore some clarity and certainty for investors looking to support low-carbon projects and cleantech.

"You can't invest $2-3 billion into a country only to find that every four years the rules have changed."

Disclosure of climate-related financial risk

Trillions of dollars are invested in projects that may be impacted by a changing climate. This exposure is increasingly viewed as a major risk to the global financial system by groups such as the Bank of England, the G20, and the Financial Stability Board (FSB) (a G20 body that monitors major risks to the global financial system). The Financial Stability Board therefore created a Task Force on Climate-related Financial Disclosures (TCFD), which has developed a voluntary set of recommendations to improve disclosure of financial risks related to climate change, and help investors, lenders and others make better-informed decisions.

Climate-related risks facing investors and companies include both:

1. transition risks – these include policy changes, climate-related litigation, new low-carbon technologies, market shifts, and reputation risk, and

2. physical risks – these can be acute (i.e., extreme weather events) or chronic (i.e., higher temperatures and sea levels), and multiple risks can occur at once.

A request for review submitted through the *Environmental Bill of Rights* in November 2017 called for provincial regulatory changes requiring disclosure on climate-related risk for entities regulated by the Ontario Securities Commission. The Ministry of Finance denied this application in March 2018, pending the outcome of a review by the Canadian Securities Administrators (CSA). The CSA review was published in April 2018, and recommended the development of guidance and educational initiatives to help companies improve disclosure. The ECO agrees that this is a minimum necessary step.

Case study: Pension funds and financial disclosure

Up to US$2.5 trillion (1.8% of global assets) are already at risk due to climate change – this number is certain to rise in the future. Given their long-term investment horizon, pension funds are uniquely exposed to climate-related risks in their investments.

Pension funds are uniquely exposed to climate-related risks.

Ontario's five largest public sector pension funds control over $400 billion in assets and serve more than 1.3 million members. These include current and retired teachers, healthcare workers, and local and provincial government employees.

Some have begun to take steps to address climate change, through greater disclosure of climate risk, shifting investments into clean energy and smart meters (e.g., a recent $200-million investment by Ontario Teachers' Pension Plan (OTPP) in Stem Inc., a commercial energy storage company looking to scale up its operations in Canada), and including environmental, social and governance considerations as part of its due diligence.

At least two Ontario public sector pension funds – OTPP and Ontario Public Service Employees Union Pension Trust (OPTrust) – have endorsed the Task Force on Climate-related Financial Disclosures recommendations calling for greater disclosure of climate-related financial risk (see above). The Government of Canada has also set up an expert panel, on which OTPP is represented, to advise the government on financial disclosure and investments to tackle climate change.

OTPP, OPTrust and the Ontario Municipal Employees Retirement System joined with a group of G7 investors – together representing more than $6 trillion in assets under management – to further speed up the "implementation of uniform and comparable climate-related disclosures under the FSB-TCFD framework" in June 2018. This includes creating an advisory committee to assess current efforts to adopt the TCFD recommendations and public sample guidance for other institutional investors, and promoting climate disclosure among their portfolio companies.

Despite this progress, Ontario's pension funds still lag behind others both in Canada and globally. Four of the five funds received a 'C' or 'D' rating on disclosure from the Asset Owners' Disclosure Project (only OPTrust was awarded a 'B' grade). And in 2015 three Ontario pension funds were found to be the most at risk from fossil-fuel stranded assets in Canada, putting their members' pensions at risk from long-term shifts in commodity prices or government regulations.

The Caisse de dépôt et placement du Québec has set an example for Ontario to follow. With $300 billion assets under management, the Caisse is Canada's second-largest pension fund. It has recently set ambitious targets to increase investments in renewables, reduce the carbon footprint of its investments, and has begun to link staff compensation to performance. If Ontario's pension funds were to follow the Caisse's lead and target 8% of their assets towards clean energy investments, this could eventually result in an additional $20-30 billion flowing to low-carbon projects, although not necessarily in Ontario.

Table 3.3. Ontario public sector pension funds and action on climate change.

Source: Task Force on Climate-related Financial Disclosure (TCFD), July 2018; Asset Owners Disclosure Project (AODP), 2017 Global Climate Index; pension fund websites and annual reports.

Pension Fund	Assets under management (billions, 2017)	Number of members	Who it serves	Endorsed TCFD recommendations?	AODP Rating
Ontario Teachers' Pension Plan	$189	323,000	School teachers / administrators	Yes	C
Ontario Municipal Employees Retirement System	$95	482,000	Local government employees	No	D
Healthcare of Ontario Pension Plan	$78	339,000	Healthcare workers	No	D
Ontario Public Service Pension Plan	$27	81,000	Provincial employees	No	D
Ontario Public Service Employees Union Pension Trust	$20	92,000	Ontario Public Sector staff	Yes	B
Total	**$409**	**1,317,000**			

De-risking low-carbon investments

Energy efficiency projects, cleantech and other low-carbon solutions are often perceived as risky by investors, e.g., due to long payback periods, discounted future cash flows, or the small size of borrowers and loans. A number of financing tools exist to lower or share this risk between the public and private sectors. These have the potential to unlock large pools of capital.

A provincial loan guarantee is one option that has been widely used by governments (including Ontario) and international aid agencies to finance clean energy projects since the 1990s. Provincial loan guarantees backstop the risk and provide confidence for private lenders to allocate capital, offer improved rates, or lighten eligibility restrictions for small borrowers.

Other credit enhancement tools include loan-loss reserve funds, first-loss bonds, and energy savings performance insurance. These all act to share the risks from loans or investments between public and private sectors, and encourage greater private investment in low-carbon projects.

A loan guarantee fund can help mobilize private capital to finance energy efficiency, clean energy and low-carbon infrastructure.

The Organisation for Economic Co-operation and Development estimates that loan guarantees can leverage $6-10 of private capital for every dollar of public support. In the buildings sector, loan guarantees have been used to promote third-party investment in efficiency retrofits across the spectrum, from single-family housing to apartments to commercial and public buildings.

Ontario has ample experience with loan guarantees for farmers, regional business investment, and First Nations energy projects. The government could create and administer a loan guarantee fund to help mobilize private capital to finance energy efficiency, clean energy and low-carbon infrastructure, or as one of a portfolio of financing tools as part of a green bank (see below).

Case study: Community investment in low-carbon energy

Another potential source of funding for low-carbon solutions is clean energy co-operatives or other forms of joint community investments. Individual and community funders, like other private investors, have proven willing to invest in Ontario if they can expect a reasonable return on their money. The availability of feed-in tariffs led Ontario residents and businesses to invest millions in renewable electricity co-operatives over the last decade. Late in its mandate, the previous provincial government eliminated these tariffs for new projects in favour of net metering.

Small changes in provincial policy could encourage joint community investments in clean energy and efficiency.

Net metering projects do not currently make financial sense for most customers, and will make even less sense if the government is successful in further reducing power rates. However, as technology costs continue to drop, relatively small changes in provincial policy could encourage co-operatives or other forms of joint community investments in clean energy and efficiency, without driving up costs for other users.

Solar farm in Sarnia. Photo credit: Enbridge Inc.

In particular, the government should encourage Ontarians to invest by crediting generators fairly for the higher value of electricity they produce when demand is high, and by allowing virtual net metering for group or community projects. No one makes money selling power in a net metering project. But virtual net metering can allow individuals or businesses to pool their funds (e.g., through a community fund or co-operative) to develop larger-scale renewable energy projects, and use the electricity generated from the projects to offset their own electricity consumption. Larger co-operative systems are more economical to install and operate than smaller systems, and may have more suitable sites available. Virtual net metering can also allow businesses with multiple locations to add solar at their most suitable locations, and to use the resulting power to offset some of their electricity use at other sites.

Building the scale of low-carbon investment opportunities

Many investment opportunities in clean energy or energy efficiency are by their nature small and difficult for institutional investors (e.g., pension funds and commercial banks) to support. These large investors generally look for opportunities in the $100 million and up range, and do not have the appetite or capacity to make multiple investments in $1-5 million community energy or building retrofit projects.

3

One way of addressing this is to set up a specialized bank or revolving fund that acts as an aggregator of multiple small projects, to create portfolios of the appropriate size and diversified risk to appeal to larger investors.

Figure 3.13. Basic revolving loan fund model.

The Atmospheric Fund

The Atmospheric Fund (TAF) is a small but very successful revolving fund of $45 million. Established by the City of Toronto in 1991, TAF finances and co-finances local projects that generate both a financial and environmental return on investment, and operates at no cost to the taxpayer. Serving the Greater Toronto and Hamilton area, TAF has invested more than $60 million in a range of projects that reduce energy and emissions. Projects include retrofits of residential and city buildings, transportation options, waste reduction and local electricity generation. These efforts have saved the city, citizens and businesses significantly more than $60 million in energy bills, and helped Toronto reduce its GHG emissions 24% below 1990 levels.

Such a bank or revolving fund could be publicly capitalized, pool capital from a variety of sources (public and private), and provide project financing through affordable loans, loan guarantees, and performance incentives and contracts. It could be designed to be self-sustaining through a mixture of loan repayments and investment returns, with a specific goal of targeting high-GHG reducing projects with high upfront capital costs and longer than average payback periods. It could also play a role in developing clean energy and technology markets by increasing consumer and investor demand.

There are many examples of banks and revolving funds to draw on, including in Ontario, the U.S. (e.g., California, Connecticut, New York State, Rhode Island, Texas), and at the national level (e.g., Australia, Malaysia, Japan, United Kingdom, Switzerland, Germany). Generally, these have been initially capitalized with public funds, including economic stimulus funds in the U.S. in 2009, which created dozens of energy efficiency focused revolving funds.

Once initial capitalization and start-up costs are paid, these agencies or corporations can continue almost indefinitely by covering operating costs through investment returns and loan repayments, making them a highly efficient financing mechanism for reducing emissions, with many other public benefits including improvements to air quality.

Connecticut's Green Bank
The Connecticut Green Bank was launched in 2011 by the state government with a goal of financing energy efficiency and renewable energy projects for residential and commercial buildings. It has two revenue sources: a ratepayer charge for energy efficiency rebates; and proceeds from the regional carbon market. The Green Bank acts as both a retail and wholesale lender, offering loans for individual projects (e.g., commercial building upgrades with repayments tied to property taxes) and credit enhancements for other lenders, such as banks, to underwrite projects. Since its launch, the bank has invested more than US$1 billion in green energy projects, created over 13,000 jobs, and leveraged $8 in private investment for every $1 in public funds.

3.4.5 Next steps and recommendations

Ontario needs substantial investments across the economy in low-carbon technologies and infrastructure. Where is the money to come from? We have identified a number of resources, including public, private, and utility funding, that could be deployed towards this challenge.

The good news is that this potential low-carbon funding is in the billions of dollars, and some of it could be deployed rapidly. For example, using the public sector's significant buying power can save energy, reduce operational costs and cut GHG emissions – while also demonstrating and supporting Ontario's leading cleantech sector.

Potential low-carbon funding is in the billions of dollars.

Similarly, removing tax breaks for dirty fossil fuels could raise much needed funding for cleaner alternatives, while at the same time leveling the playing field and making low-carbon energy more attractive to private investors.

To unlock funds for the low-carbon investments needed in Ontario, the government should:

- make the best possible use of remaining cap and trade funds
- qualify for federal low-carbon funding, by complying with the Pan-Canadian Framework
- phase out inefficient and wasteful fossil fuel subsidies
- expand utility conservation programs
- use public sector procurement to lead by example and support Ontario's cleantech sector
- require financial disclosure of climate risk for all entities regulated by the Ontario Securities Commission
- create a revolving loan fund to provide capital for energy efficiency, fuel switching and clean technology, and
- conduct a review of Greenhouse Gas Reduction Account initiatives in a timely and transparent manner, and continue to fund valuable and effective projects.

3

3.5 Regulating climate polluters

Abstract

Emission-reduction regulations are the third key element of effective government action to reduce greenhouse gas emissions. A strong set of regulations to reduce emissions is especially important if Ontario is not going to put a price on carbon or invest heavily in solutions. Regulations must enforce emission reductions in many parts of the economy, but may also allow market-friendly flexibility. Regulations that collect information, and enable or encourage voluntary reductions are also valuable, but must work together with stronger policies.

Regulations can be very effective at reducing emissions. Keeping the electricity sector clean may need new regulations to prevent natural gas emissions from climbing. Beyond electricity, Ontario needs to deal with growing emissions in the transportation, buildings and waste sectors. Some key examples are highlighted here for these sectors.

3

Contents

3.5.1 Why regulations?

Emission reduction regulations are the third key element of effective government action to reduce greenhouse gas (GHG) emissions. If Ontario is neither going to make polluters pay a price on carbon nor invest heavily in solutions, the only major option remaining is a robust set of regulations to reduce emissions.

In many jurisdictions, regulations do most of the heavy lifting. Ontario has already demonstrated how effective a regulatory approach can be. Ontario's ban on the use of coal for electricity generation produced the largest GHG emission reduction in North America of any government action. For comparison, Ontario's avoided annual emissions from eliminating coal are nearly triple the reductions expected from a $50 per tonne federal carbon tax.

In many jurisdictions, regulations do most of the heavy lifting.

In economic theory, reducing emissions with regulations will cost an economy more than making polluters pay. But regulations tend to be more popular with the public than a visible price on carbon pollution and are therefore usually more effective at reducing emissions. There is a lot of evidence for the importance of public support; Ontario's retreat from its cap and trade program is just the latest example.

3.5.2 What types of regulations?

Ontario can choose from a range of regulations to reduce GHG emissions. At one end of the spectrum are command-and-control regulations, which order individuals or businesses to use a specific technology with little or no flexibility to comply. These regulations, if enforced, produce results. Ontario's coal ban is the best example.

At the other end of the spectrum, technology-neutral performance standards can set pollution limits, but use market-friendly flexibility to reduce the overall cost. For example, Canada's proposed Clean Fuel Standard would require a declining average GHG intensity of transportation and heating fuels. Fuel providers have the flexibility to sell a range of lower-carbon fuels, including ethanol, but also biodiesel, renewable natural gas, hydrogen and electricity. Costs would be kept down because companies with cheaper ways to cut emissions can sell credits to companies that do not.

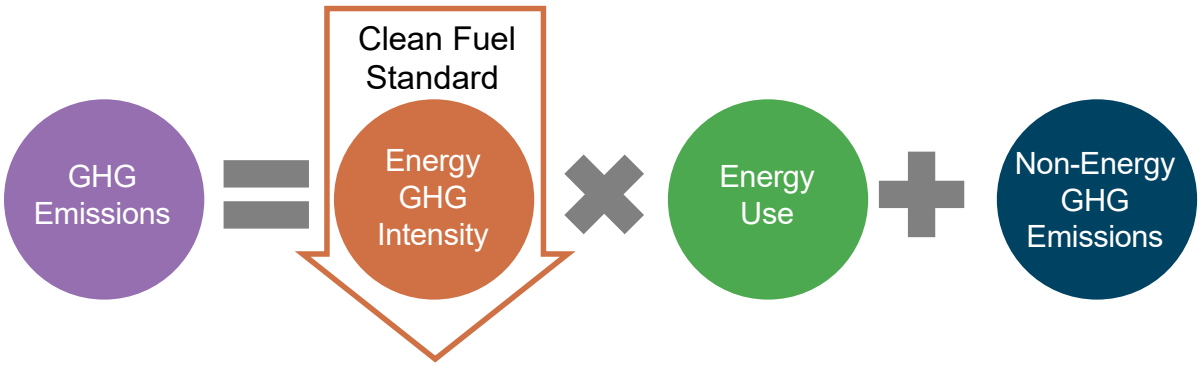


Figure 3.14. Economy-wide greenhouse gas emissions (GHG) are driven by a number of different factors. For example, the proposed federal Clean Fuel Standard will reduce energy GHG intensity, but without a high carbon price, other regulations are also needed to achieve deep cuts to overall GHG emissions.

Regulations that enforce GHG emission cuts are best complemented by supportive regulations that enable and encourage further reductions. For example, stronger land use plans can enable more people to choose lower GHG lifestyles. The mandatory disclosure of energy use can encourage building owners to improve energy efficiency.

Regulatory options that can enforce, encourage or enable GHG emission reductions are discussed below for:

- electricity
- transportation
- buildings, and
- waste.

These are sectors with GHG emissions that have grown since 1990 or, in the case of electricity, have only shrunk due to effective government regulation. These are also sectors that can use existing technologies as low-GHG alternatives.

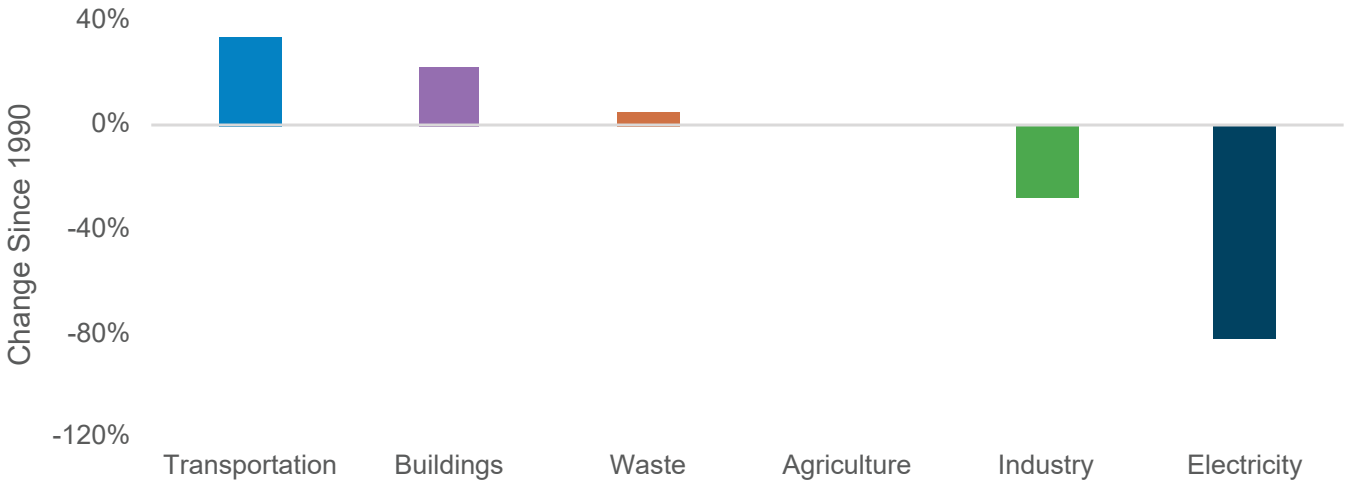


Figure 3.15. Percentage change in Ontario's GHG emissions since 1990. Ontario's transportation, building and waste sector GHG emissions have each increased.

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A11-12, page 29.

Is regulation bad for the economy?

California is an outstanding model for Ontario. The state is a sub-national government with a fast-growing economy and an extensive regulatory system designed to reduce emissions. The state's economy has recently grown to become the fifth largest in the world (just behind the U.S., China, Japan, and Germany). At the same time, California has used flexible regulations to achieve 90% of its emission reductions, and hit its 2020 target four years ahead of schedule.

California has used flexible regulations to achieve 90% of its emission reductions, four years ahead of schedule.

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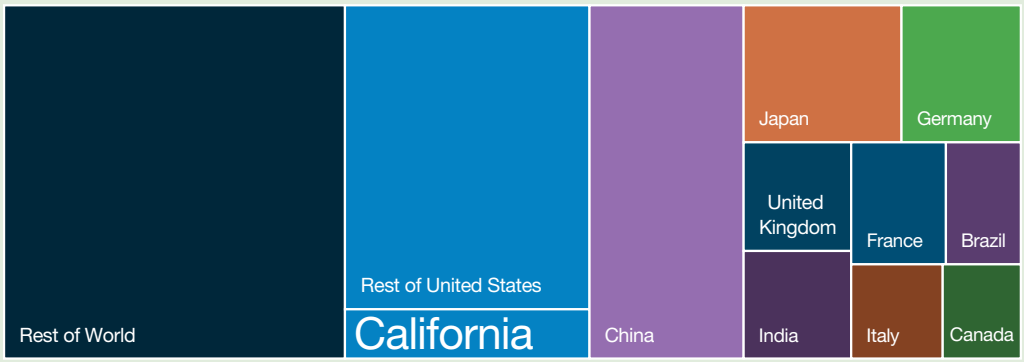


Figure 3.16. California was the world's fifth largest economy in 2017.

Source: The World Bank, GDP; Statista, Gross Domestic Product (GDP) of the United States in 2017, by state.

In 2017, China was the fastest growing major economy. It explicitly uses environmental regulations to both improve local air quality and to strategically spur economic growth. China is already the leader in both the use and export of solar panels and wind turbines. The country is now using aggressive regulations to leapfrog over existing automotive powerhouses and capture the growing electric vehicle market.

Figure 3.17. China was the fastest growing major economy in 2017.

Source: The World Bank, 2017 GDP growth (annual %); Statista, Annual percent change of the real GDP in California from 2000 to 2017; Statscan, Gross domestic product by industry: Provinces and territories, 2017.

3.5.3 Regulating electricity

In 2017, a remarkable 96% of Ontario's grid electricity came from nuclear and renewable power sources, i.e., only 4% came from fossil fuels. As neither nuclear nor renewable power sources generate carbon emissions while operating, all Ontario businesses and institutions received an important boost in reducing their carbon footprint. Clean, low-carbon electricity is fundamental to reducing Ontario's emissions and providing options for a low-carbon economy.

Clean, low-carbon electricity is fundamental to Ontario's options for a low-carbon economy.

Unfortunately, this achievement is now in peril. Several factors could result in a resurgence in the proportion of Ontario electricity generated by fossil fuels, primarily natural gas. These include:

- hotter summers, which push up air conditioning demand
- the cancellation of 752 renewable energy contracts and the scheduled closure of the 3-gigawatt Pickering nuclear power plant, which will reduce Ontario's supply of clean electricity by 2024
- the cancellation of cap and trade, which will lower the cost of natural gas, and
- the Independent Electricity System Operator's proposed Market Renewal policies, which could favour natural gas power plants.

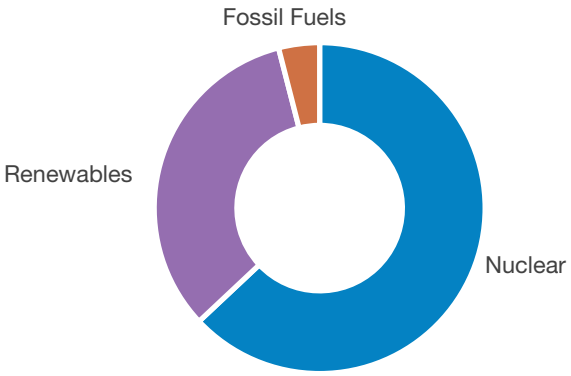


Figure 3.18. A remarkable 96% of Ontario's grid electricity came from nuclear and renewable power sources in 2017.

Source: IESO, Transmission-Connected Generation, 2018.

Clean electricity standard

Although Ontario currently has remarkably clean and reliable electricity, to keep it this way, the government should consider a clean electricity standard. British Columbia, which provides an effective example of this flexible, performance-based system, requires at least 93% of electricity to be generated from clean or renewable resources. A similar approach could work well in Ontario.

3.5.4 Regulating transportation

After electricity, transportation emissions should be a primary target of Ontario climate change policy. Transportation is Ontario's largest and fastest growing source of GHG emissions since 1990. The technology already exists to drastically reduce transportation GHG emissions. Ontario's manufacturing sector stands to directly benefit economically from producing the new technologies. Reduced traffic pollution can result in major public health savings.

Several regulatory options for reducing transportation GHG emissions include:

- a zero emission vehicle standard
- a vehicle pollution limit, and
- transit-supportive land use plans.

After electricity, transportation emissions should be a primary target of Ontario climate change policy.

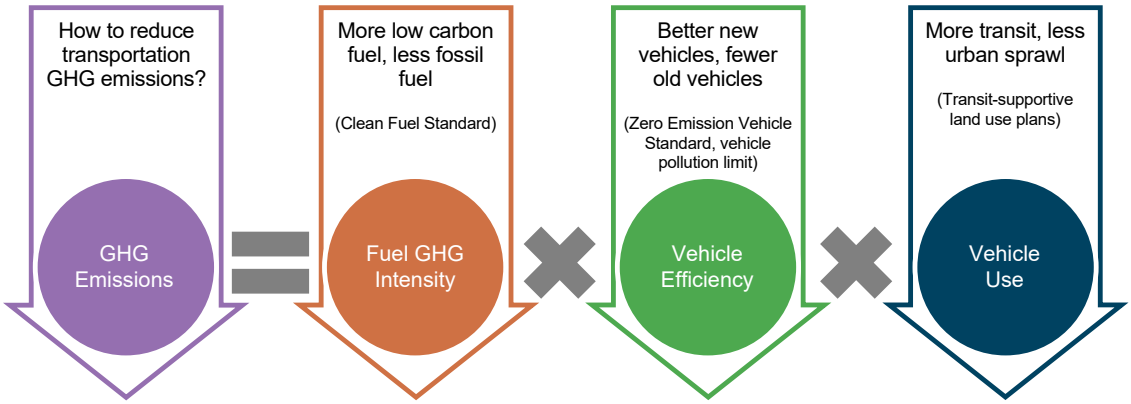


Figure 3.19. The complexity and continued growth of the transportation sector emissions means a range of regulations are required to reduce its emissions.

Zero emission vehicle standard

While some zero emission vehicles are on the road today in Ontario, many more are needed (see section 3.1). Despite decades of incremental improvements to transportation fuels, and the vehicles that use them, transportation GHG emissions continue to grow.

A zero emission vehicle standard is an effective, market-friendly, flexible policy.

A zero emission vehicle standard is a market-friendly, flexible policy that has been effectively used in California and other jurisdictions. The policy requires automakers to sell an increasing number of zero emission vehicles over time. Flexibility is provided by allowing the sale of a range of vehicle technologies to earn credits, which can be traded among companies. Fully electric vehicles earn more credits than hybrid vehicles. In combination, a zero emission vehicle standard and the proposed federal Clean Fuel Standard can complement each other and reduce the cost of cutting GHG emissions. The combination is much more cost effective than publicly-funded subsidies for electric vehicles.

Putting the onus on car companies to sell zero emission vehicles can solve some problems consumers face. Electric vehicles are already cheaper to fuel and maintain than gasoline vehicles, and have competitive ownership costs when driven long distances (see Figure 3.20). The upfront price of electric vehicles will soon also be competitive (see Figure 3.21). Unfortunately, many car dealerships suffer from a lack of electric vehicle availability and staff training. Dealers also face a

high cost to install onsite infrastructure to charge and to service electric vehicles. This investment may be difficult to recover without either subsidies or regulations to encourage electric vehicle sales.

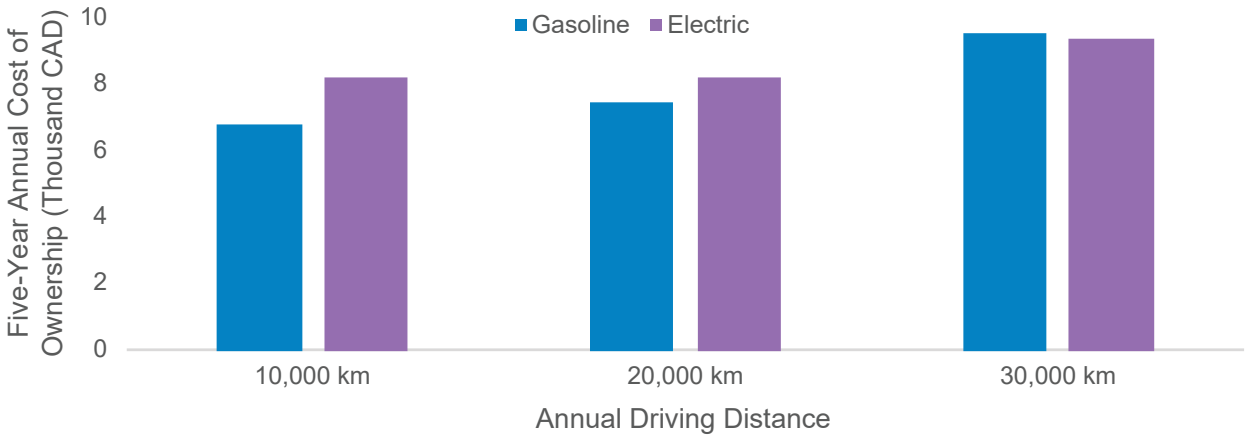


Figure 3.20. Total electric vehicle ownership costs can be competitive with gasoline vehicles, depending on how much the vehicles are driven. The 2018 Ford Focus SE 5D Hatchback is compared to the 2018 gasoline-powered Ford Focus Electric 5D Hatchback here.

Data Source: Canadian Automobile Association (2018).

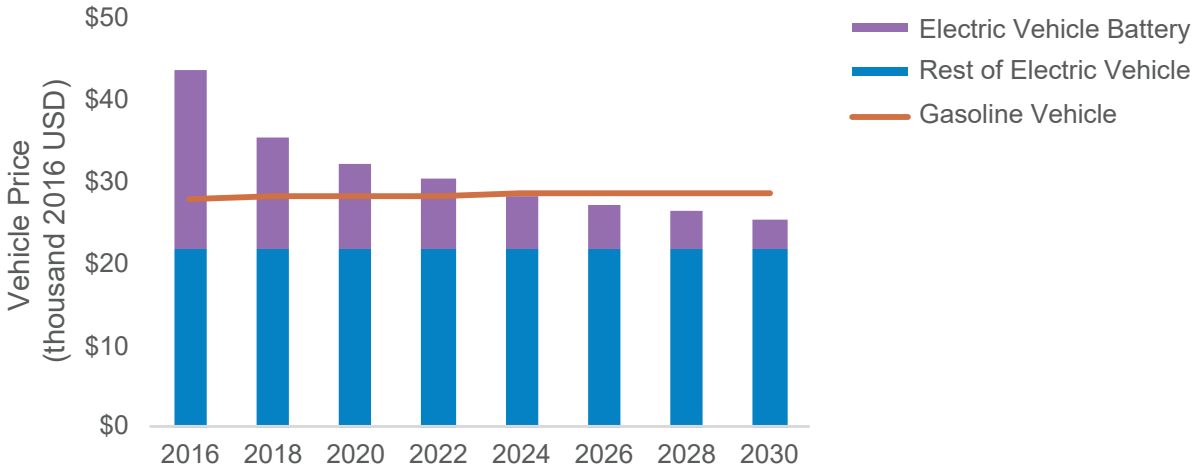


Figure 3.21. Rapidly falling battery costs are on track to allow electric vehicles to be competitively priced with conventional vehicles within a decade.

Data Source: Bloomberg New Energy Finance (2018).

California first adopted a zero emission vehicle standard in 1990. The policy has changed over time to adapt to improved technology. Not only has it reduced GHG emissions, it has also provided other valuable benefits. In particular, the policy has helped California spur economic innovation and improve local air quality. As explained below, these could also be co-benefits for Ontario.

Economic opportunities

An Ontario zero emission vehicle standard could support clean energy jobs. More zero emission vehicles could:

- use made-in-Ontario electricity, either directly (in batteries) or indirectly (as hydrogen)
- reduce costs in Ontario's electricity grid by providing a market for surplus electricity generated overnight, and
- increase opportunities for Ontario's cleantech industry, including hydrogen technology companies.

A zero emission vehicle standard in Ontario could increase the value for automakers of manufacturing these vehicles in Ontario. Numerous electric vehicle companies have begun production in California, where demand is high. China's New Energy Vehicle policy is similar to California's Zero Emission Vehicle standard. In June 2018, Aurora, Ontario-based Magna International announced plans to build consumer electric vehicles – not here – but in China, where electric car sales are booming. As the president of DesRosiers Automotive Consultants describes the situation, "being in a market that accepts them is a critical element to manufacturing." Eleven other North American jurisdictions with a combined market of over 100 million people already have a zero emission vehicle standard.

3

Vehicle pollution limit

Gasoline-powered vehicles not only release GHG emissions, but also contribute to local air pollution. Public Health Ontario warns there are dangerous amounts of air pollution from fossil fuel vehicles around major roads across the province. Toronto Public Health reports that local traffic made the largest contribution to air pollution related hospitalizations in 2014.

Local traffic made the largest contribution to air pollution related hospitalizations.

A zero emission vehicle standard and feebates can increase the uptake of cleaner, new vehicles, and Drive Clean has helped ensure that older cars are maintained. But old, heavily polluting vehicles can remain on the road for decades. Ontario should follow in the footsteps of jurisdictions around the world that have effective policies to get the most polluting vehicles off the road.

Ontario regulates air pollution from industrial facilities by setting pollution limits. The same strategy could limit vehicle emissions by banning or heavily taxing old, higher emission vehicles, perhaps combined with a "cash for clunkers" program.

These regulations could be focused on urban areas where traffic-related air pollution is highest, and on the older, heavy-duty diesel vehicles that release the majority of smog-creating air pollutants. Diesel exhaust from trucks and buses is a known carcinogen. Unfortunately, Ontario's Drive Clean program only requires diesel vehicles to pass an opacity (visual) test, which is low-cost but does not accurately measure air pollution.

Buses are arguably most important to clean up.

Buses are arguably most important to clean up. School buses carry children, who are especially vulnerable to harm from air pollution. Transit buses carry a lot of passengers through the busiest parts of our cities and towns, so they expose the most people to air pollution and also add to the noise burden in urban areas. Both types of buses operate for many years. Although some bus routes already have competitive life cycle costs for electric versus diesel buses, electric buses have

higher purchase prices. Toronto has committed to only purchase zero emission buses by 2025. To prevent locking in high emissions for many years, Ontario municipal transit and school bus fleets should likewise avoid buying new diesel buses.

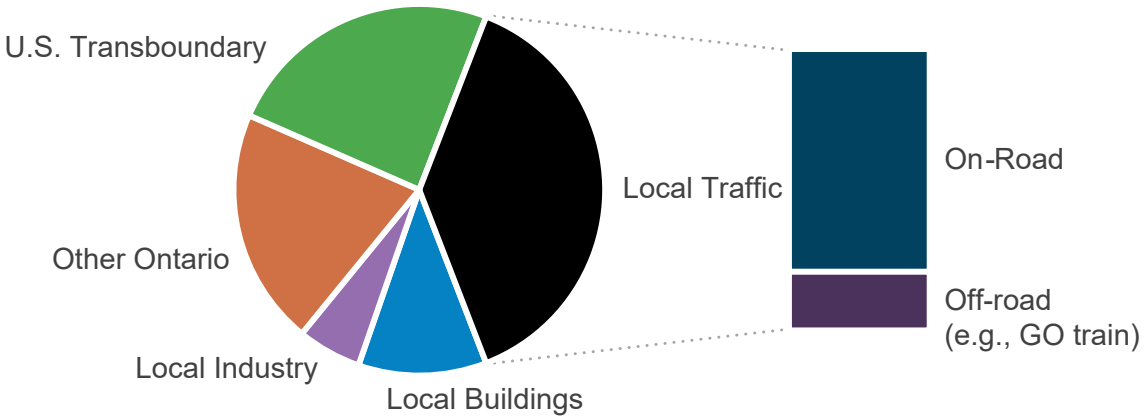


Figure 3.22. Causes of of air pollution related hospitalizations in Toronto.

Data source: Toronto Public Health (2014) Path to Healthier Air: Toronto Air Pollution Burden of Illness Update.

Cancelled electric bus programs

The cancellation of the cap and trade program, and the corresponding loss of revenues, has eliminated provincial funding for three electric bus projects.

- Electric School Bus Pilot Program – 13 school bus operators and one First Nation received their funding to purchase an electric school bus through this pilot program before it was cancelled. This program was particularly important because children have developing lungs and immune systems and are thus uniquely vulnerable to diesel exhaust.
- Electric Municipal Buses fund – York Region and the City of Brampton were relying on this funding to help purchase 14 electric buses as part of the Pan-Canadian Electric Bus Trial. This important trial is organized by the Canadian Urban Transit Research & Innovation Consortium, and partly funded by federal and municipal governments. Its key objective is to prove viability and to develop common standards, which would allow North American industry to better compete with international companies.
- Municipal GHG Challenge Fund – The Cities of Toronto and Hamilton were planning to use this funding to help each city purchase electric transit buses for their own pilot programs. Toronto has informed the ECO its pilot will proceed with continued funding from the federal government, but the scope of its planned order of 60 buses may have to change. Hamilton warns it may now have to purchase higher-emission diesel buses.

Transit-supportive land use plans

Transportation is Ontario's largest and fastest growing source of GHG emissions. It is mainly because urban sprawl forces people to drive longer distances to get where they need to go, contributing to growing traffic congestion. By contrast, those who live close to work do not have to drive as far, or have other options such as transit, cycling or walking. Ultimately, good land use planning provides choices and frees Ontarians from being locked into long commutes, high gasoline bills, high emissions and time away from loved ones.

Urban sprawl forces people to drive longer distances.

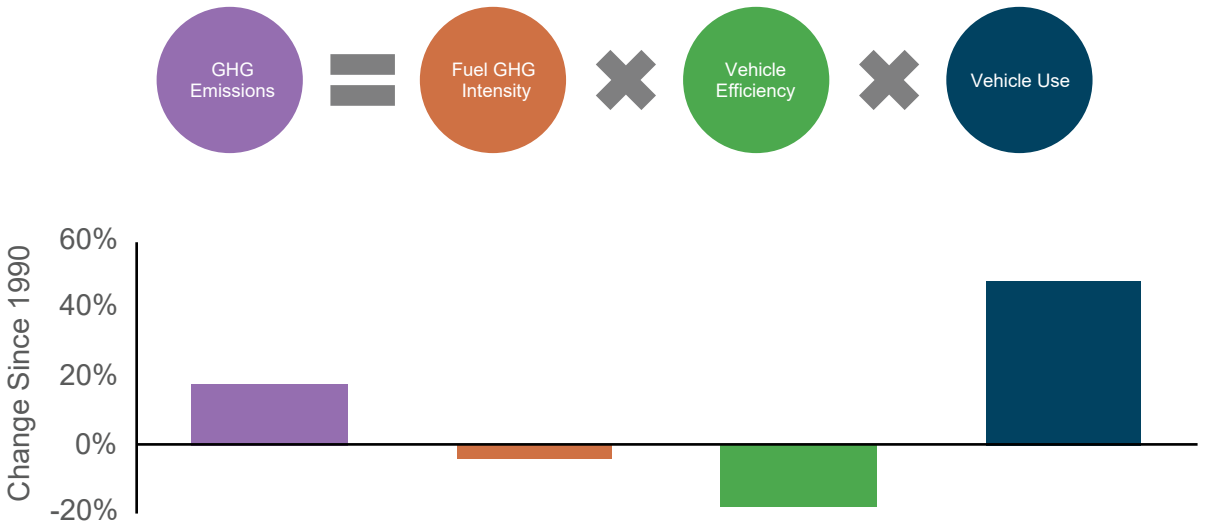


Figure 3.23. Growth in passenger road transportation greenhouse gas (GHG) emissions since 1990. Despite improvements in fuel GHG intensity (in grams of CO_2e/litres of fuel) and vehicle fuel efficiency (litres of fuel per passenger-km), vehicle use has grown (in passenger-km).

Data Source: Natural Resources Canada (2018) Comprehensive Energy Use Database, Transportation Sector Ontario Table 10: Passenger Road Transportation Secondary Energy Use and GHG Emissions by Energy Source.

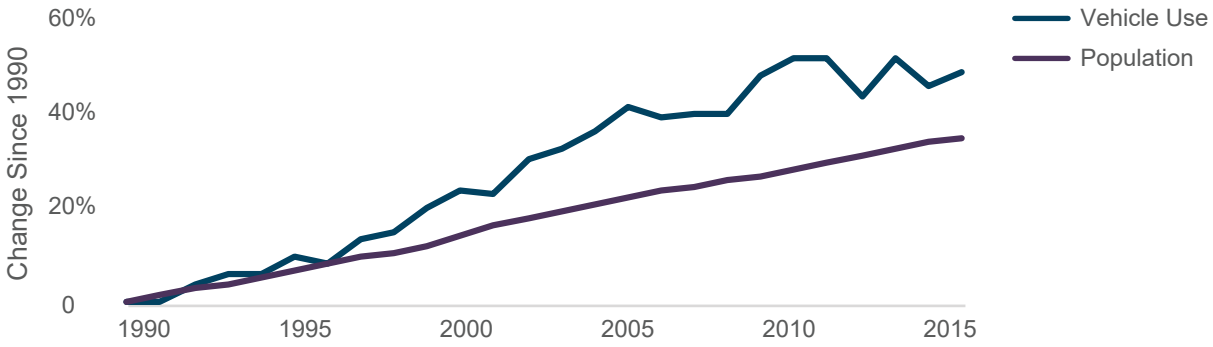


Figure 3.24. Growth in vehicle use in Ontario has exceeded population growth.

Data Source: Natural Resources Canada (2018) Comprehensive Energy Use Database, Transportation Sector Ontario Table 10: Passenger Road Transportation Secondary Energy Use and GHG Emissions by Energy Source; Statistics Canada, *Population by year, by province and territory* (2018), CANSIM Table 051-0001.

At a minimum, the provincial government should ensure that the recently updated Growth Plan for the Greater Golden Horseshoe is effectively implemented, reduces sprawl, and creates complete communities with less dependence on fossil fuels. The Growth Plan includes a number of policies to accommodate the more than four million new residents expected in the region by 2041. These include municipal targets for urban density (the number of residents and jobs in a given area) and intensification (the precentage of new housing within existing built-up areas). Together, these targets support more cost-effective and reliable transit, and strive to reduce the area of prime farmland and natural areas paved over for sprawl.

Municipalities have a key role reducing vehicle use through smart urban planning.

It is up to municipalities to implement the Growth Plan, through the Municipal Comprehensive Review process, municipal official plans and local zoning regulations. But the province can reject municipal plans that do not meet the Growth Plan's densification and intensification objectives and should do so. For example, the province can reject municipal requests for lower targets for multiple reasons. The province has other tools at its disposal to encourage implementation, including:

- tying transit and infrastructure funding to achieving higher densities
- providing financial or capacity support for smaller municipalities to conduct planning studies, and
- regularly monitoring and reporting on progress towards the Growth Plan's targets.

Municipalities also have a key role to play in reducing vehicle use through smart urban planning. For example, most housing in Ontario is either low-density single family homes, or high density apartments and condos. People looking for affordable family-friendly housing near transit, jobs and services often have few choices.

One way to address this is to encourage greater supply of "missing middle" housing. This medium-density housing includes duplexes, triplexes, townhouses, mid-rise apartments, and laneway housing. Municipalities can achieve this through zoning reforms (e.g., as-of-right zoning such as Toronto's proposed Development Permit System) that allow a greater range of housing in existing urban neighbourhoods, as well as targeted efforts to reduce red tape and streamline approvals for missing middle housing.

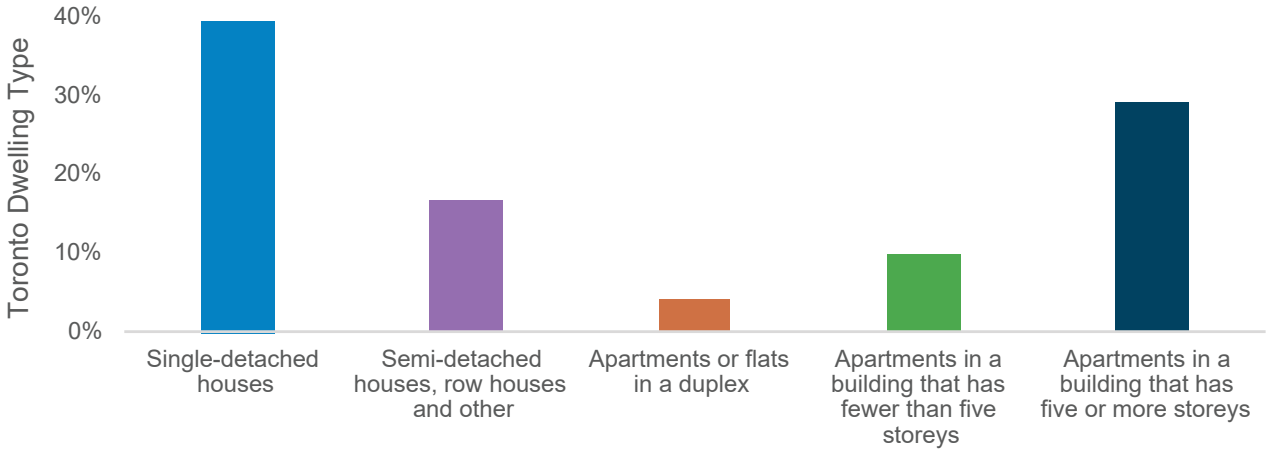


Figure 3.25. Medium-density housing is in short supply within Toronto.

Source: Statscan, Dwellings in Canada, Table 2: Occupied private dwellings and types of dwelling, by census metropolitan area, 2016 Building regulations.

Although medium-density development is suitable for many areas, major transit hubs and corridors should support high-density development. Today, many transit stations do not serve enough people to be cost-effective or do much to shift behaviour and reduce GHG emissions. More development in these areas would increase the benefits of these major public investments.

3

Failing to protect forests will make Ontarians more vulnerable to climate extremes.

Land use planning to protect carbon sinks

Good land use planning can also protect natural carbon sinks, which pull carbon out of the atmosphere. Growing forests are particularly effective at capturing carbon – though not nearly enough to offset the vast amounts of human-caused GHG emissions. Failing to protect forests exacerbates climate change and will make Ontarians more vulnerable to climate extremes.

Ontario's Oak Ridges Moraine Conservation Plan is just one example of the type of regulation needed to protect natural lands. Others are discussed in the ECO's 2018 Environmental Protection Report.

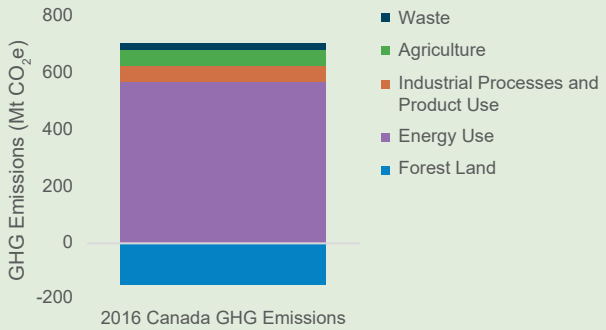


Figure 3.26. Greenhouse gas emissions (in megatonnes of carbon dioxide equivalent) by sector and the emissions sequestered by Canada's forests. Forests help reduce Canada's impact on the climate.

Source: Environment and Climate Change Canada, *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (2018), Part 3, Table A9-2, page 10.

3.5.5 Regulating buildings

Greenhouse gas (GHG) emissions from Ontario's buildings come mostly from using natural gas for space and water heating. While the technology exists to dramatically reduce fossil fuel use and GHG emissions, previous weak regulations mean that Ontario's existing buildings waste a lot of energy. That means unnecessarily high heating bills for residents and businesses.

Regulatory options for more fossil fuel efficiency in buildings include:

1. strengthening building codes and standards, and
2. requiring transparency and disclosure.

In this chapter, the ECO outlines opportunities to improve building regulations. While we use mostly homes for examples, these regulations can also apply to institutional, commercial and industrial buildings. We have added more ideas for complementary regulations for emission reductions in buildings in textboxes.

Strengthening building codes: lower energy use and bills

Stronger building codes would reduce the use of natural gas and electricity, and energy costs for Ontarians.

New buildings

Improving the energy efficiency of Ontario's new buildings offers an opportunity to both reduce carbon pollution and save people money on energy bills. Designing buildings to be energy efficient from the start is by far the most cost-effective approach. It requires some extra construction costs upfront, but these are typically small, and are paid back through lower energy bills in reasonable time. Extra construction costs are

expected to decline over time with economies of scale and construction experience. Investing in energy efficiency could be a significant net benefit to Ontario's economy, increasing gross domestic product (GDP) (see section 1.5).

The federal government is working with provinces to create a model 'net zero energy ready' building code by 2030. But it is up to individual provinces to adopt these efficiency standards. Strengthening the Ontario Building Code (OBC) would not only help Ontarians reduce their energy bills, but could also help minimize any loss of our highly skilled construction workforce to provinces where ongoing building energy efficiency efforts may create more opportunities. Ontario also has the opportunity to set higher performance standards, like B.C.'s Energy Step Code, and encourage municipalities to set their own local standards, like the Toronto Green Standard. The provincial government should set a stringent GHG-intensity performance target. This could future-proof our buildings by encouraging fuel switching to lower-carbon energy supplies, in particular, electricity (see section 1.5 for the benefits of this approach).

Improvements to the OBC are typically made on a five-year cycle. The latest update for new buildings took effect in 2017, and aimed to improve the efficiency of housing by 15%, and large buildings by 13%, relative to the previous code requirements. The provincial government started consultation on the next round of proposed energy improvements to the OBC in fall 2017, but has not made a decision on them.

Improving energy efficiency and reducing home energy bills

New construction in Canada is generally more energy efficient than older buildings, but could be very much better. For example, as modelled by EQ Building Performance, an average new home in 2018, built to meet today's OBC, uses about 50% less energy compared to the average Ontario home. A typical EnergyStar home, built to meet more stringent voluntary energy efficiency guidelines, is 20% better than a new home built to code. By contrast, a certified passive house, built to a super-efficient voluntary standard, uses significantly less energy for heating and cooling than a new home built to code. There is a lot of room for improvement.

Renovating existing buildings

Ontario also needs to upgrade existing buildings that waste energy, built when energy requirements in the OBC were weak. For example, around 50% of existing homes (from before 2016) are expected to still be around in 2050. The poor energy performance of older buildings will persist unless they are renovated for energy efficiency. Every time a building is built or renovated to weak energy efficiency standards, the resulting poor building performance is locked in until the next upgrade. For example, putting in low-quality windows today means the building will have poor energy performance for 20 years or more. Upgrading the energy efficiency of existing buildings is key to reducing their fossil fuel use and resulting GHG pollution.

As proposed in the most recent consultation, the OBC should be updated to require minimum energy efficiency standards for all major renovations, not just new additions. For example, energy efficiency standards could be enforced like fire and structural safety requirements. They could be checked whenever a building permit is required or the building envelope is changed.

Requiring energy efficiency improvements in existing buildings will result in lower energy bills (see Figure 3.27), with added co-benefits to comfort, health, resilience of the building, reduced need for energy infrastructure, and increased affordability over time.

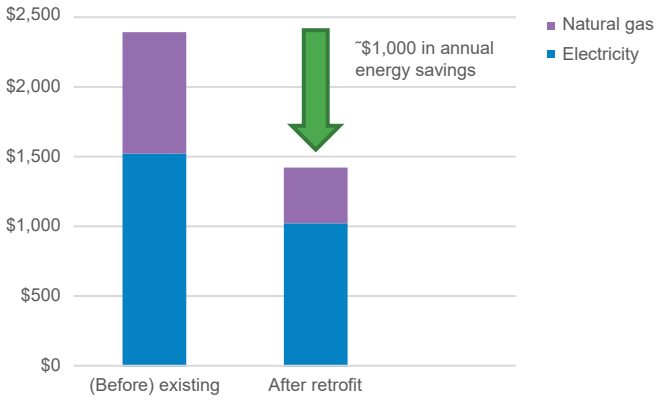


Figure 3.27. Estimate of annual energy costs before and after retrofits to an average Ontario home. Depending on the state of the existing building and its energy sources, deep energy retrofits typically reduce energy use by 50% to 70%. Given that an average annual home energy cost in Ontario is about $2,400, the savings could be about $1,000 per year. Energy cost savings could be significantly higher after renovating older, drafty and poorly insulated homes.

Fixing our existing public buildings

Ontario's public buildings, like hospitals, schools and government offices, use vast amounts of energy, and the public should hold the government accountable for this energy use. Ontario could unlock enormous financial, energy and GHG savings by supporting energy efficiency upgrades for existing public buildings, allowing the government to save taxpayers' dollars. Improving the energy efficiency of public buildings was a major focus of the greenhouse gas reduction programs funded by cap and trade revenues (see Appendix B).

Regulating efficiency of equipment

The province should also continue to update minimum energy performance standards for appliances and products sold in Ontario, such as natural gas furnaces and hot water heaters. Ontario has the option of harmonizing standards with other jurisdictions, developing its own original efficiency standards, or adopting voluntary leading-edge standards as mandatory Ontario standards.

Mending the split incentive in rental buildings

Around 85% of Ontario's rental apartment buildings are over 35-years old, and these older buildings typically have poor energy efficiency. Unfortunately, property owners have little incentive to upgrade the energy efficiency of buildings and appliances when tenants pay the energy bills. But when landlords pay the utility bills, tenants have little incentive to reduce their energy use. And, although landlords can apply to increase rent beyond inflation for upgrades, the process can be difficult with no guarantee it will be approved.

The potential for energy efficiency gains, if these barriers can be overcome, is large.

Minimum energy efficiency requirements for existing multi-unit rental buildings could help overcome this hurdle, reduce emissions and help keep energy costs down for the most financially-vulnerable Ontarians. Programs to share the energy savings between landlords and tenants is another option. For example, on-bill financing programs can provide both landlords and tenants with energy savings incentives (see section 3.4 for more financing options). Disclosure of energy costs could also create market pressure for more efficient buildings (see section 3.5.5).

Commercial office buildings have made more progress on energy efficiency because vacancy rates are higher and they must compete harder for tenants.

Building materials

Some building materials help decrease energy use once buildings are occupied, but at the expense of extremely high emissions in manufacturing or installation processes. For example, some types of spray-applied polyurethane foam insulation create very high emissions. Phasing out these materials can expand the market for other types of insulation that are lower-carbon. Prohibitions and restrictions are also leading to innovation; spray foam manufacturers are developing new blowing agents that significantly reduce the global warming potential of their products. Fortunately, there are often low-carbon alternatives, some of them made-in-Ontario, and new innovative low-carbon products are being researched and developed.

Some building materials actually store carbon, meaning new building projects could become carbon sinks instead of carbon emitters.

Two ways to minimize emissions released during the manufacturing and installation of building materials are to:

1. prohibit, restrict or phase-out the sale of high-GHG materials that have effective low-GHG alternatives; this process could drive innovation and complement the regulation of ozone-depleting substances and volatile organic compounds
2. require new, large buildings and major renovations to quantify and report their total carbon footprint, including operational, manufacturing and installation and then phase-in future performance targets. The current OBC does not address the total carbon footprint.

Wood is a low-carbon material

One of Ontario's advantages is our forest industry, which provides an ample supply of low-carbon structural material: wood. Both the climate and Ontario's forestry industry would benefit from increased use of wood construction. In 2014, Ontario amended the OBC to increase the allowable height of wood buildings from four to six storeys. Ontario's Tall Wood Reference for *alternative* code solutions provides guidance for the use of mass timber for buildings over six storeys. However, multiple reasons, including the costs and timelines associated with seeking special approvals to construct tall wood buildings, often cause builders to opt for concrete or steel instead. Widespread use of wood would likely increase if the OBC considered tall wood as an *acceptable* solution. This low-carbon material is already used for 12-storey buildings in Quebec. An 18-storey building has been built in British Columbia, and there are several 8- to 14-storey wood demonstration projects in progress in Ontario.

3

Transparency: benchmarking and disclosure

In the European Union, every large public building must post its energy consumption in its lobby. This is a powerful motivator to create more energy-efficient buildings. Building managers must focus on the issue, and it harnesses competitive instincts and encourages building managers to improve their public image.

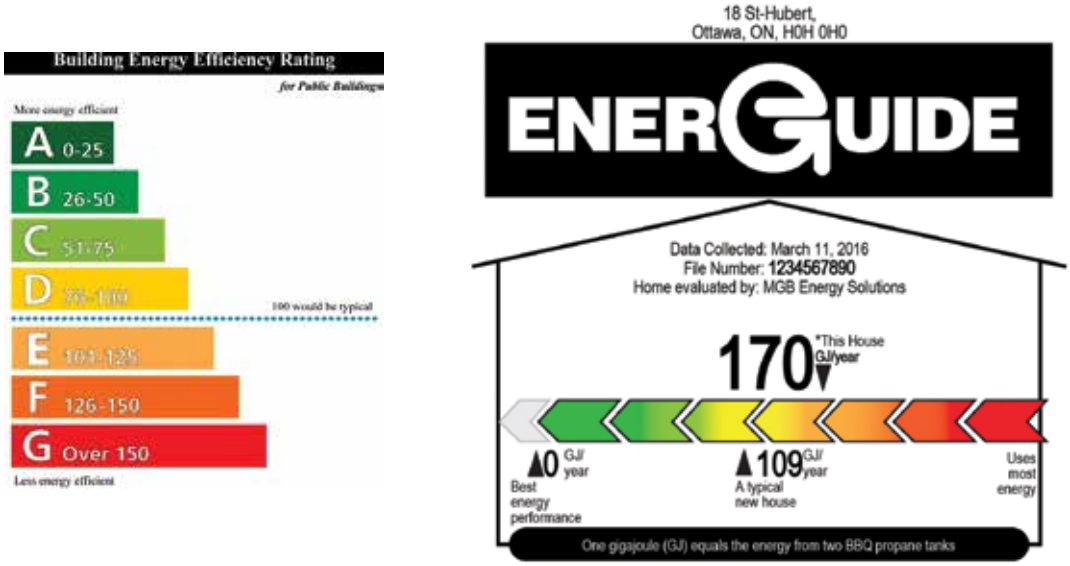


Figure 3.28. Examples of building Energy Performance Certificate rating from the U.K. and Canada's EnerGuide rating system for homes.

Sources: Energy Policy, Volume 68. Development of a new energy efficiency rating system for existing residential buildings, at 219. EnerGuide example from Natural Resources Canada.

Standardized energy benchmarking allows for meaningful comparison across buildings. Building operators can see anomalies, be alerted to inefficiencies, and find energy savings. For example, benchmarking requirements for commercial buildings has improved the efficiency of the private sector in 24 jurisdictions across the U.S. A study of best practices in the U.S. found reported energy savings from benchmarking of up to 14% within just two to four years.

Ontario has tried some energy benchmarking and disclosure already. A 2011 regulation (O. Reg. 397/11 made under the *Green Energy Act, 2009*) requires some energy disclosure by broader public sector buildings, and a 2017 regulation (O. Reg. 20/17 made under the *Green Energy Act, 2009*) requires energy and water disclosure by large private commercial buildings. The 2011 public sector regulation has already proved its worth by driving municipalities to pursue sustainable energy projects, and could do much more if it were easier to use and more comprehensive. Additionally, current broader public sector reporting leaves out some relevant data, including social housing (20% of municipal electricity use and 37% of municipal natural gas use), and other uses like public fleets, streetlights, and water and sewage pumping. The Ontario government should continue to require increased reporting, leading to more competition in public and commercial spaces.

Requiring public display of results in building lobbies could also help improve public awareness and energy-reduction efforts. In multi-unit residential buildings, renters could make more informed decisions about total costs of rental units before moving in, possibly encouraging landlords to invest in energy efficiency upgrades and partially addressing the split incentive barrier.

Ontario does not yet require disclosure for residential, single-family homes at time of listing homebuyers. The EnerGuide label is ready-to-use, and the *Green Energy Act* contains the relevant provision, but it was never proclaimed. Requiring energy transparency at time of listing can motivate homeowners to improve their home's performance for higher sale prices and to be competitive in the housing market.

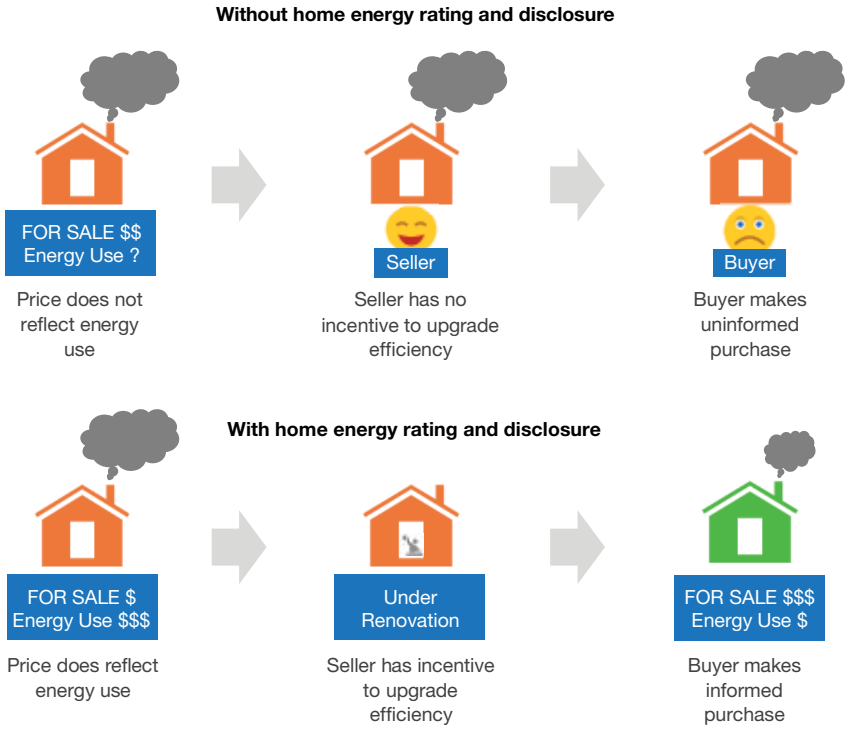


Figure 3.29. The benefits of Home Energy Rating and Disclosure. Requiring disclosure often encourages voluntary renovations to improve sale value, as sellers get fair value for their investments. Without disclosure, sellers are more likely to make cosmetic renovations that do not improve energy efficiency.

Energy reporting and benchmarking provide the information needed to spotlight buildings with poor energy performance. This could support enforcement of mandatory upgrades to minimum energy performance standards for rental buildings or for renovations, for example. It is important to continue strengthening and expanding transparency and disclosure efforts to encourage best-in-class energy efficiency for buildings in Ontario.

3.5.6 Regulating waste

The waste management sector is responsible for several million tonnes of GHG emissions (CO_2 equivalents) every year. These emissions mainly come from the decomposition of waste in landfills. As Ontario continues to grow, so does the challenge of handling waste. Nobody wants the odour, pollution, and garbage truck traffic from landfills near their neighbourhood. A City of Toronto strike in 2009 that halted garbage pick up highlighted the importance of good service. A U.S. temporary ban on waste imports after 9/11, Michigan's ban on Ontario residential trash, and China's recent ban on contaminated foreign recyclables mean Ontario should not rely on other jurisdictions to take our trash.

Organic waste landfill ban

Organic waste is the most GHG polluting type of garbage, when landfilled. This waste produces methane-intensive landfill gas, much of which is released into the atmosphere. To keep methane out of the atmosphere, organic waste should be banned from landfills. This waste can be diverted to anaerobic digesters, which are more effective at capturing methane for use as a valuable energy resource. Organic waste can also be diverted to facilities to produce compost, which that can improve the productivity of Ontario's soil.

To keep methane out of the atmosphere, organic waste should be banned from landfills.

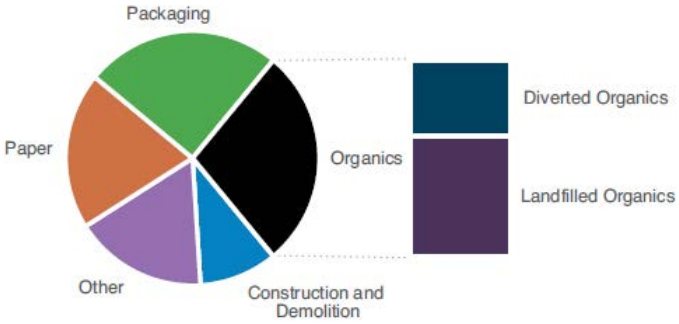


Figure 3.30. Ontario's largest category by mass of waste is organics, which are mostly disposed into landfills, rather than diverted to produce compost or energy.

Source: The ECO's 2017 Special Report, *Beyond the Blue Box*, Figure 1.2, page 12; Figure 3.5, page 33.

Extended producer responsibility is key to a low-carbon circular economy.

Extended producer responsibility

Although Ontario has had success recycling non-organic waste, there is still a lot of room for improvement. A greater reliance on extended producer responsibility policies can shift costs away from consumers and municipalities and towards companies that manufacture the products that become waste, and are in the best position to find innovative ways to reduce it. After all, consumers and municipalities are not the ones who design excessively packaged products that are disposable, or difficult to repair and recycle. Extended producer responsibility is key to a low-carbon circular economy.

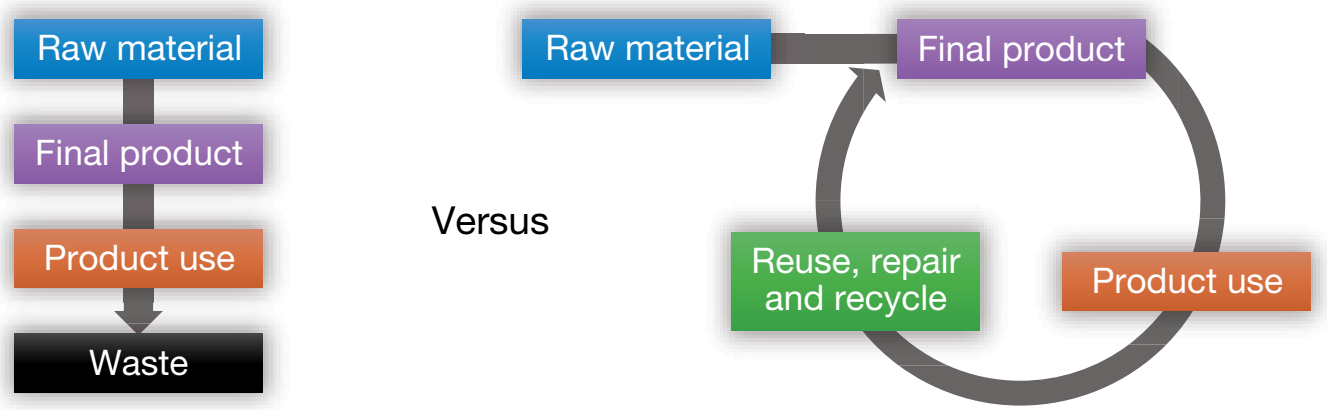


Figure 3.31. Moving from a linear to a circular economy can reduce waste and the associated greenhouse gas emissions.

3.5.7 Regulating climate-related financial risks

Smart decisions require good information. Ontarians deserve transparency not only as voters, taxpayers and consumers, but also as investors and pension beneficiaries. Unfortunately, just as the energy efficiency information of a home is hidden from prospective buyers, a company's exposure to the financial risks and costs of climate change are hidden to prospective investors. The Canadian Chamber of Commerce recognizes climate change as one of its top 10 barriers to competitiveness. The costs include decreases in product demand (e.g., fossil fuel use) and increases in insurance costs (e.g., due to floods).

The G20 initiated Task Force on Climate-related Financial Disclosures has created a framework for consistent disclosures of climate risks in the financial system. Such disclosures could accelerate shifts in capital investments. For example, the Caisse de dépôt et placement du Quebec is one of the 20 largest pension funds in the world (see section 3.4.4). It is in the process of shifting its over $300 billion in investments to reduce the GHG emissions of its portfolio by 25% by 2025.

Smart decisions require good information.

Provincial securities regulators across Canada are considering mandatory climate-related financial disclosure. Mandating disclosure in Ontario would help protect Ontario investors from acquiring undisclosed climate risks, and allow small and large investors alike to make informed decisions.

Mandatory climate-related financial disclosure would also help reduce some uncertainty. Publicly traded companies are already required to report financial risks. However, a lack of clarity regarding climate-related risks leaves publicly traded companies vulnerable to lawsuits regarding whether or not annual reports are adequately informing investors of relevant risks. In light of this uncertainty, the City of Toronto has commissioned a study on the implications of climate-related financial disclosure for the city.

3.5.8 Moving forward with regulations

Ontario's ban on coal-generated electricity has shown that regulations can be very effective at reducing emissions. But keeping the electricity sector clean may need new regulations to prevent natural gas emissions from reversing these gains.

Beyond electricity, Ontario needs to deal with growing emissions in the transportation, buildings and waste sectors. The regulations discussed above are examples that address the many unique aspects of these sectors:

- new and existing vehicles (personal and commercial)
- development around major transit hubs/corridors and in existing low-density neighbourhoods
- new and existing buildings (residential and commercial)
- organic and inorganic waste

A strong set of regulations to reduce emissions is needed. Especially if Ontario is not going to make polluters pay and use the proceeds to invest in solutions. Regulations must enforce emission reductions in many parts of the economy, but may also allow market-friendly flexibility.

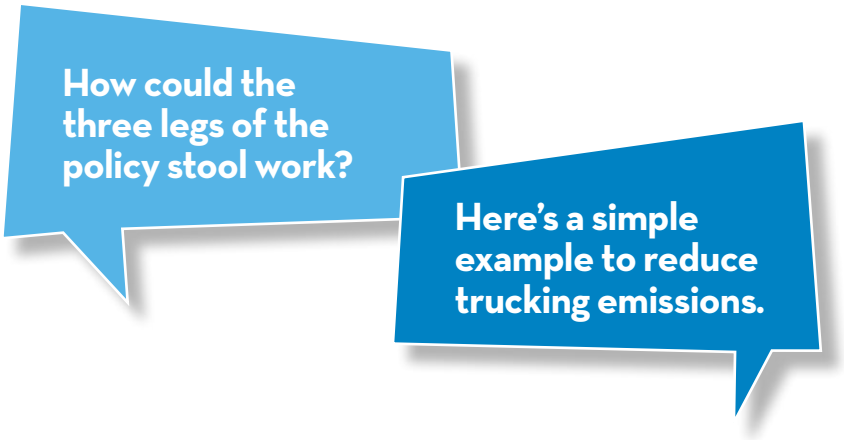
Regulations that require the collection of information, and enable or encourage voluntary reductions, are also valuable, but must work together with stronger policies.

3.5.9 Recommendations

To ensure Ontario achieves the emission reductions that are necessary to minimize climate disruption, the Ontario government should:

- adopt a stringent clean electricity standard to prevent natural gas electricity emissions from increasing
- use a zero emission vehicle standard to increase the uptake of new, cleaner vehicles
- set a vehicle emission pollution limit to eliminate highest emission vehicles and protect public health
- ensure the Growth Plan for the Greater Golden Horseshoe effectively reduces the need for fossil fuels
- strengthen the Ontario Building Code for new and existing buildings to enhance energy efficiency and reduce GHG emissions
- continue to require increased reporting of building energy use, leading to more competition in public and commercial spaces as well as homes
- ban organic waste from landfills to reduce landfill gas emissions, and
- use extended producer responsibility requirements to reduce non-organic waste.

A good climate policy considers the specific circumstances of each sector. Section 3.6 and Appendix A contain some examples of other sector-specific recommendations.



3.6 Applying the three-legged stool: freight

Abstract

Freight is the province's fastest growing source of greenhouse gas (GHG) emissions, and the only subsector whose emissions have doubled since 1990. Here is a simple example of how to use the three legs of the policy stool to reduce freight emissions. By combining a polluter-pay approach with investments in solutions, a revenue-neutral feebate on truck sales would both unlock investments in low emission trucks and discourage high emission trucks without raising taxes. Together with a "cash for clunkers" program (investment in solution), a pollution limit on emissions from diesel trucks (regulation) would take the dirtiest, most polluting trucks off the road. Road pricing and fuel taxes (both polluter-pay) could slow the growth in truck kilometres driven, which is the biggest contributor to the growth in GHG emissions from freight.

Contents

3.6.1 Why freight?

Freight is the province's fastest growing source of greenhouse gas (GHG) emissions, and the only subsector whose emissions have doubled since 1990. Reducing GHG emissions from freight is critical to a successful climate strategy.

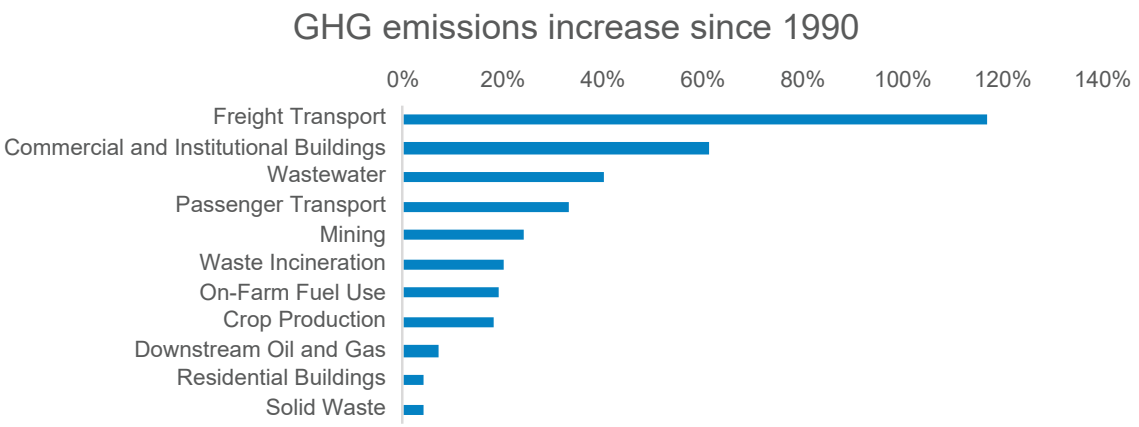


Figure 3.32. The percentage increase in GHG emissions of economic subsectors whose emissions have grown since 1990.

Source: Environment and Climate Change Canada, National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada (2018), Part 3, Table A12-7, page 53.

Ontario's (and Canada's) policies have not been strong enough to stop this doubling in freight GHG emissions. These policies have included:

- fuel taxes and licence fees
- a short-lived provincial price on carbon
- road pricing on Highway 407 and Highway 412
- the Greener Diesel Regulation, which requires 4% bio-based content in the freight sector's primary fuel source
- Drive Clean, which helps require that truck air pollution emission control systems are maintained, and
- recently cancelled subsidies for freight trucks of various environmental value through two short-lived iterations of the Green Commercial Vehicle Program.

The federal government also regulates the GHG emissions of all new trucks. As discussed in the ECO's 2017 Greenhouse Gas Progress Report (Ontario's Climate Act: From Plan to Progress), this has helped but has not stopped the dramatic emissions increase.

Natural gas trucks accelerate climate change

Ontario's now cancelled Green Commercial Vehicle Program subsidized the cost of some technologies, but not all of them were good for the climate. For example, the government supported the purchase of natural gas-fueled trucks. But natural gas trucks may not reduce GHG emissions due to the current rate of natural gas leakage upstream. Natural gas has lower direct carbon emissions than diesel at the point of combustion, but a lot of the carbon in natural gas goes into the atmosphere unburned, via leaks from wells, pipelines and other natural gas infrastructure. As discussed in the ECO's 2017 Greenhouse Gas Progress Report (Ontario's Climate Act: From Plan to Progress), unburned natural gas (i.e., methane) is a GHG emission that is short-lived but extremely potent, so these leaks can more than offset the apparent benefits of natural gas over diesel.

Many peer-reviewed, scientific studies are warning against the use of natural gas trucks. Increasing natural gas use increases methane emissions, which accelerates climate change, especially over the short term (e.g., 20 years). Even in the long-term (e.g., 100 years), the impact of natural gas trucks on the climate is not markedly better and potentially worse than diesel trucks. Reviving subsidies for replacing diesel trucks with natural gas trucks would therefore be bad climate policy.

Is renewable natural gas the answer? Unfortunately, no. Farms, landfills and organic waste treatment facilities produce methane-rich biogas/landfill gas that could be upgraded to renewable natural gas and injected into the natural gas pipeline, to displace fossil natural gas. The ECO strongly supports maximizing renewable natural gas in Ontario's natural gas system. However, the potential for renewable natural gas production in Ontario cannot meet existing demand for natural gas from the pipeline system, and there is none left over to fuel natural gas trucks. Trucks fueled by sources of renewable natural gas that are not connected to the natural gas pipeline system are a limited exception.

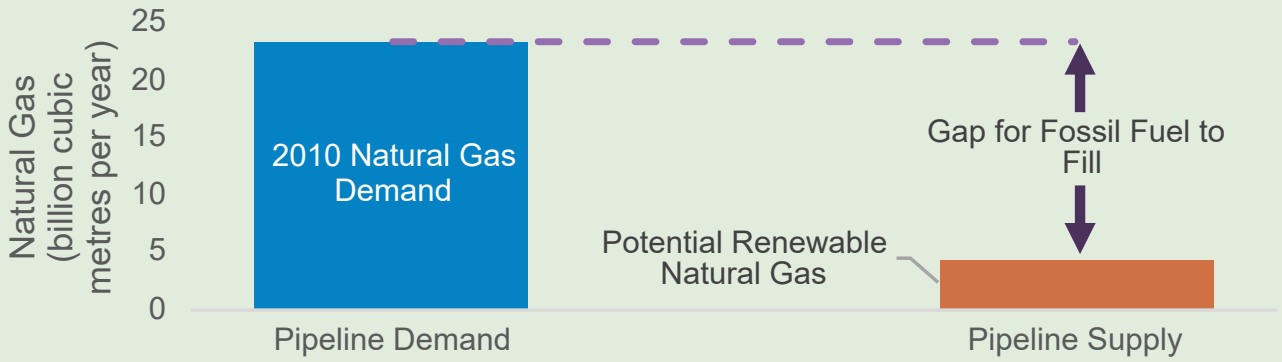


Figure 3.33. Renewable natural gas cannot satisfy existing natural gas demand in Ontario. Fossil fuels will be used to fill this gap. Increasing natural gas demand will therefore increase fossil fuel use.

Source: S. Abboud and B. Scorfield, Potential of Renewable Natural Gas from Ontario Wastes (2011) at Figure 7.

Since existing policies have not been enough to stop the growth of GHG emissions from trucking, how could the three legs of the climate change policy stool help?

3.6.2 New trucks: revenue-neutral feebate

By combining two legs of the stool, a revenue-neutral feebate on truck sales would unlock investments in low emission trucks (rebate) and discourage the purchase of high emission trucks (rebate) without raising taxes.

To minimize administrative costs, a feebate system should be directed at truck manufacturers in Ontario, not at individual purchasers. In essence, all manufacturers of new trucks would report the numbers and emission levels of the trucks they sell in Ontario each year. A standard formula could calculate the net fee or rebate applicable to each manufacturer based on the average emissions of each truck sold compared to a benchmark emissions level.

In a revenue-neutral system, all money collected from manufacturer fees would be paid out to manufacturers of cleaner vehicles through rebates. This system is not a tax; the government takes no net revenue from the trucking sector. Instead, the feebate redistributes funds from one truck manufacturer to the other, in order to reward those selling the most zero and low emission vehicles. The leading jurisdiction for this type of system is France.

A feebate system can be used at any stage of technology development, and long before the trucking sector will be ready for a zero emission vehicle standard, as discussed in section 3.5. And unlike Ontario's previous consumer-focused subsidy for zero emission vehicles, this system would not impose an administrative burden or cost on vehicle dealerships.

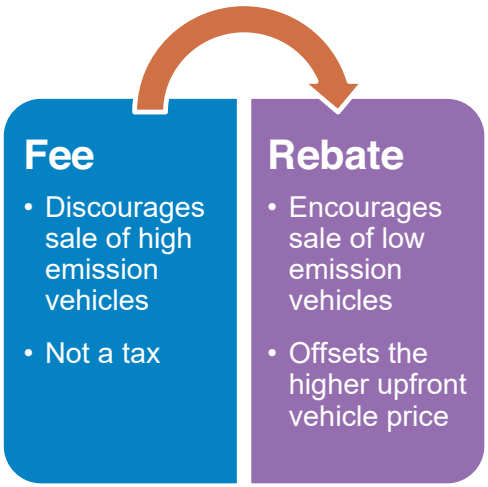


Figure 3.34. A revenue-neutral feebate combines polluter-pay with funds for solutions.

3.6.3 *Old trucks – pollution limit*

While a feebate system can incentivize the purchase of new, lower-emissions trucks, old trucks can remain on the road for decades. As discussed in the ECO's 2017 Greenhouse Gas Progress Report (Ontario's Climate Act: From Plan to Progress), there are health and climate benefits to getting old trucks off the road. Old trucks generally have higher GHG emissions and release the most toxic air pollutants, which create smog and damage human health.

Generally speaking, the older the truck, the weaker the GHG and toxic air pollution emission standards were when it was manufactured; some of the oldest trucks were built prior to any emission standards. By regulation, the provincial government could impose air pollution and GHG emission limits on trucks operated in Ontario. If desired, these limits could be strategically focused on urban areas (where traffic-related air pollution and the affected population are highest), as London, England has done.

To reduce the burden on low-income truckers, the provincial government could combine this with the "cash for clunkers" program recommended in the ECO's 2017 Greenhouse Gas Progress Report (Ontario's Climate Act: From Plan to Progress). The two programs together could go a long way to get the dirtiest, oldest trucks off the road.

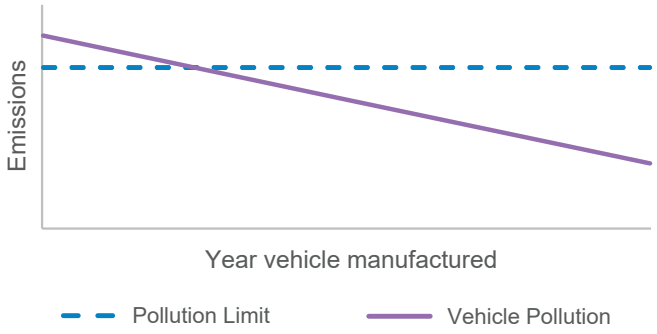


Figure 3.35. A vehicle pollution limit could be based on vehicle age.

3.6.4 All trucks – distance driven

These two initiatives would increase the number of cleaner trucks and reduce the number of the dirtiest trucks. They would not reduce the steady growth in truck kilometres driven, which is the biggest contributor to the growth in GHG emissions from freight.

As explained in the ECO's 2017 Greenhouse Gas Progress Report (Ontario's Climate Act: From Plan to Progress), and in section 3.3 of this report, road pricing is a type of polluter-pay system that can both avoid inefficient trucking and improve the efficiency of Ontario's roads. Well-designed road pricing can help offset current pressures to store inventory in distant warehouses and rely on long-distance trucking to deliver it when needed, and can also dramatically cut congestion.

The provincial and municipal governments may need road pricing revenues more than ever. Climate change may drive up road maintenance, and other adaptation costs, as well as health care impacts from vehicle pollution. The government's plan to cut the gasoline tax will shift more of these costs from road users to all Ontario taxpayers.

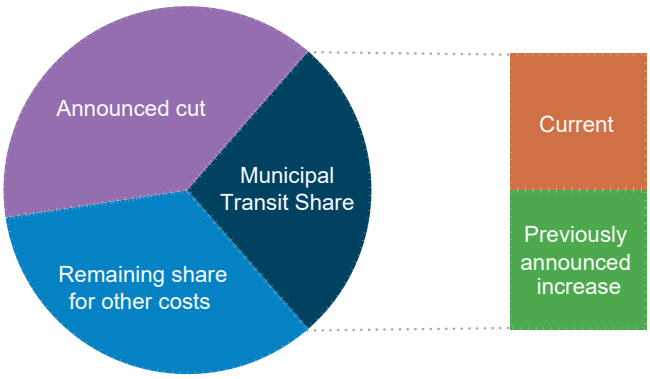


Figure 3.36. Announced changes to the gasoline tax will make it harder to pay for the all of public costs of roads and emissions from road users.

Sources: Ministry of Finance, Gasoline Tax (2018), Gasoline tax rates; Ministry of Transportation, Enhanced Gas Tax Program (2017). Increasing gas tax funding; Toronto Star, Gasoline price cuts not coming until fall, Ford government says (16 August, 2018).

Another way to discourage inefficient trucking, pay for road maintenance, and offset the cut in the gasoline tax, is to increase the diesel fuel tax. Currently, diesel has a slightly lower provincial fuel tax, and much lower federal fuel tax than gasoline, even though diesel exhaust is more damaging to human health than gasoline. It would be better public policy to increase the diesel tax.

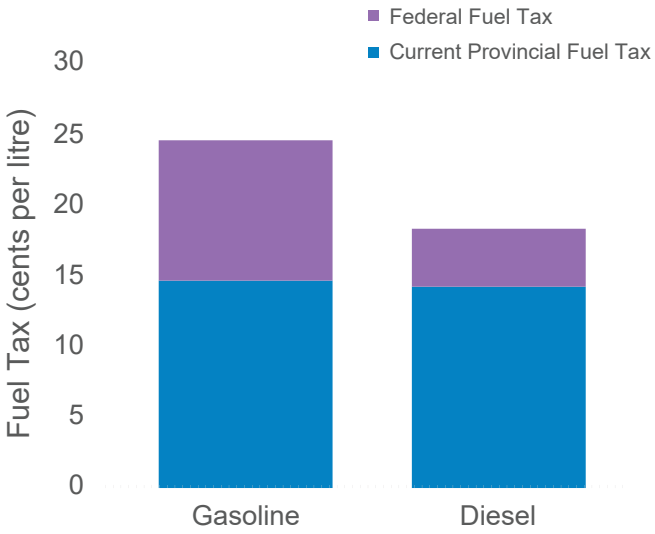


Figure 3.37. Diesel fuel taxes are currently lower than gasoline fuel taxes.

Source: Natural Resources Canada. Fuel Consumption Taxes in Canada (2017), Federal and Provincial Consumption Taxes on Petroleum Products.

Part 4:
Getting ready for what's coming

4

Abstract

4

Ontario can help limit future climate disruption by reducing our emissions of climate-disrupting greenhouse gases. But greenhouse gas emissions to date (and locked-in) mean that some climate change will continue, so we also need to get ready to face the changes that will come.

There are many things that Ontarians can do to make our communities and ourselves less vulnerable to the negative effects of climate change. This is called "climate change adaptation." Adaptation is about protecting our families, our homes, our environment, our communities and our way of life from changes to the world around us, and about finding ways to make the best of those changes. And, while the costs of adaptation may be high, the costs of not adapting to a changing climate in advance will be enormously higher.

Adaptation alone is not a solution to climate change; as temperatures increase, there will be limits on our ability to adapt. To be resilient in the face of climate change, Ontario must take both emission reductions and adaptation seriously.

While the costs of adaptation may be high, the costs of not adapting will be enormously higher.

The provincial government must provide leadership in preparing Ontario for climate change. It must ensure appropriate action by its ministries, and that municipalities, businesses and individuals have the necessary information and support to do their part. In particular, Ontario urgently needs to:

- identify and prioritize the province's vulnerabilities and risks to climate change
- provide users with consistent and accessible data on the future climate, so they know what to prepare for, and
- incent Ontarians to increase their own resilience to what's ahead.

Just as important, Ontario needs to start an open conversation about who is going to pay the enormous costs of adaptation and climate disruption.

Contents

4.1 Introduction to adaptation

Climate change is, rightfully, often in the news and in public and private conversations. Much of that talk is focused on the need to reduce greenhouse gas (GHG) pollution – known as "climate change mitigation." Reducing emissions of GHGs across the globe is vitally important to fighting climate change, to limit the extent of future warming and other climate damage. Ontario has taken some significant steps to mitigate climate change, particularly closing our coal-fired power plants. A price on carbon, such as the federal carbon tax, would also stimulate GHG reductions.

But no matter how much we reduce our emissions now, the concentrations of GHGs already in the earth's atmosphere mean that substantial additional climate changes are already locked in. Most GHGs trap extra heat for decades, centuries or longer after they are released. If we do not reduce our emissions, these changes will grow more and more extreme.

In Ontario, we have already experienced hotter, drier summer weather, warmer winters, severe flooding, fierce winds, changing water levels, agricultural losses, infrastructure damage, an increase in Lyme disease, and more (see section 1.1 of this report). Both British Columbia and Alberta have experienced extraordinary forest fires. The extra heat that GHGs trap in the atmosphere makes both higher average temperatures and these intense, severe climate extremes more likely, just as drinking alcohol before driving makes automobile accidents more likely.

These growing impacts have significant, long-term implications for our health and well-being, the environment and the economy.

Since we know that these impacts are coming (just not where and when), Ontario can and should do what we can to prepare ourselves and our communities. Thinking ahead can make Ontarians less vulnerable to the negative effects of climate change, and help us take advantage of its opportunities. This is called "climate change adaptation." Climate change adaptation can take many forms, including small shifts in individual behaviour, changing the way we plan communities and manage or conserve our natural environments, and major overhauls of critical infrastructure to reduce the vulnerabilities and risks associated with a changing climate. While mitigation works to lessen the future severity of climate change on a global scale, adaptation measures directly address the local impacts of climate disruption in Ontario's communities.

Mitigation vs Adaptation

Mitigation refers to efforts to curb climate change by reducing emissions of GHGs that cause the Earth's temperature to rise.

Adaptation refers to efforts to cope with and adjust to the impacts that have already occurred and will occur in the future as a result of climate change.

Adaptation is not a stand-alone solution to climate change, or an alternative to reducing climate pollution (mitigation). There are limits to how much human communities will be able to adapt, if and when global temperatures continue to rise. To be resilient in the face of climate change, Ontario must take action on both mitigation and adaptation.

Since we know that these impacts are coming (just not where and when), Ontario can and should do what we can to prepare.

It is the provincial government's responsibility to provide leadership and direction on adaptation. Until recently, however, the Ontario government's work on climate change adaptation has been modest, lacking strategy and co-ordination. In late 2017, under the previous Ontario government, the then Ministry of the Environment and Climate Change (MOECC) (now named the Ministry of the Environment, Conservation and Parks, or MECP) proposed a new approach to adaptation that could start to move Ontario towards greater resilience, but little of this approach has been implemented. The current government has not indicated what, if anything, it will do about climate change adaptation.

In this Part, the ECO provides an overview of the urgent need for climate change adaptation in Ontario, and examples of ways that we can adapt to some of the climate impacts that Ontario is already experiencing. We discuss the state of adaptation efforts in Ontario, and where the province needs to go from here to prepare Ontarians as best as possible for the challenges that a changing climate will bring.

4.2 Why do we need to adapt?

Here is the problem: as the planet warms and weather changes, many of the assumptions about the climate on which our communities, infrastructure and economy were built no longer hold true. Ontario's buildings, roads, farms, stormwater and electricity distribution systems were all designed based on historical climate information and with the assumption that climate was stable. Many of these systems will not have the capacity to handle the temperatures and extreme weather events that climate disruption will bring.

For example, the stormwater systems underlying many urban areas – the pipes that drain rainwater and melted snow away from city streets – were not designed to hold the increased volumes of water that more extreme storms will bring, especially when coupled with urban sprawl and the creation of too many hard surfaces. Ontario already has a huge stormwater infrastructure deficit, and a significant increase in flood-related property losses.

The assumptions about the climate on which our communities, infrastructure and economy were built no longer hold true.

Similarly, over 30 Indigenous communities in Ontario's Far North have long relied on a network of "winter roads" – temporary routes over ice and heavy snow-pack – to connect with each other and to bring in most of their year's supplies. Warmer winter weather is now choking off this lifeline, creating an expensive and environmentally disruptive need for new permanent roads.

The changing climate may also give rise to some opportunities, such as longer agricultural growing seasons, extended seasons for some recreational activities like golf and hiking, and growth of tourism and agriculture in northern Ontario. To take advantage of those opportunities, we also need to adapt.

Photo credit: Cabinet Office Photo Library.

If we do not prepare for the effects of climate change, systems will fail. The environment, the economy and people will suffer. We may also lose out on some opportunities. This is why, together with mitigation efforts, we need to take action to prepare Ontario as much as possible for these changes.

> *In urban areas climate change is projected to increase risks for people, assets, economies and ecosystems, including risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges.*
>
> Intergovernmental Panel on Climate Change (IPCC), Climate Change 2014 Synthesis Report.

4.3 What does adaptation look like?

Have you ever stocked up on food, water, batteries or other supplies in preparation for a big snow storm? In the wake of recent severe rainstorms, maybe you have taken steps to reduce the risk of flooding in your basement, such as installing a backwater valve or a sump pump. And with hotter summer weather becoming the norm, perhaps you are thinking of ways to keep yourself and your family cool, like insulating or installing ceiling fans in your home, planting more shade vegetation, or finding out the location of cooling shelters in your neighbourhood.

These are all simple examples of climate change adaptation: making adjustments to human or natural systems to cope with or prepare for changing conditions and their effects. These examples are things that individuals can do to adapt to the effects of climate change, but there are many other measures – large and small, simple and complex – that can and should be taken on a community, regional, provincial or federal scale to reduce our vulnerabilities to climate change impacts.

Adaptation measures can take many forms, including the following.

- **Physical actions:** building or updating roads and bridges to withstand more frequent freeze-thaw cycles and more intense rainfall events; preserving wetlands or other natural features to help absorb rainwater and snowmelt and reduce stormwater runoff.
- **Basing land use on future climatic conditions:** planning future land uses to avoid building in flood-prone areas; creating new provincial parks and conservation reserves to account for potential impacts of climate change on biodiversity.
- **Making or updating laws, regulations and policies:** updating building codes to require buildings to be constructed or retrofitted to withstand future climatic conditions; developing strategies and action plans to drive updates of best management practices to help farmers respond to and plan for more variable climate conditions.
- **Communicating with the public:** distributing information about an impending climate-driven event, such as extreme temperatures or rainfall, high winds and ice storms, to ensure that members of the community are alerted to the event, and making sure they know how to prepare for and protect themselves.

Everyone has a role to play in preparing for Ontario's changing climate.

Everyone has a role to play in preparing for Ontario's changing climate: individuals, the private sector, organizations, Indigenous communities, conservation authorities, municipalities, and the provincial and federal governments are all responsible for – and in many cases are – taking action. Municipalities, in particular, are responsible for a wide range of programs and services affected by climate change, such as stormwater management, public transit and local roads, planning and development, the building sector,

Photo credit: Shawn Goldberg / Alamy Stock Photo

emergency management, public health, and parks and recreation. Many municipal governments have prepared or are working on adaptation planning specific to their communities.

To illustrate, we provide some examples below of ways that we (as individuals, different levels of government, businesses and others) may be able to reduce our vulnerability to some of the climate change impacts that we are already beginning to experience here in Ontario. For more details about these and other impacts of climate change in Ontario, see section 1.1 of this report.

We must realize, however, that adaptation is not a solution to climate change or a replacement for mitigation. Adaptation actions like those identified below cannot replace mitigation as a response to climate change; we must also reduce GHG emissions. And there are limits to how much we can adapt to climate impacts; as the Earth continues to warm, our ability to adapt may decrease.

Preparing for climate-related health and safety impacts

Ontario communities can take steps to better prepare for and respond to climate-related health and safety impacts, such as extreme temperatures and weather events, poor air quality, and the emergence of climate-driven illnesses such as Lyme disease.

For example, adaptation measures could include:

- developing early warning systems for extreme weather events
- including potential climate impacts in disaster management planning
- providing cooling and warming shelters for the public
- reducing "urban heat effect" by using light-coloured pavement and roofing materials (to reflect, rather than absorb, heat) and increasing the urban tree canopy (to create more shaded areas and to cool the air through evapotranspiration), and
- educating the public about how to protect against health impacts such as heat-related illness and exposure to climate-sensitive diseases.

Air quality worsens during periods of high temperatures.

Preparing for climate-related flood risks

Some areas of Ontario are experiencing an increase in extreme flood events. Because of climate change, the frequency of these events is expected to rise.

There is no one-size-fits-all approach to preparing for the possibility of extreme rainfall events or coping with floods when they happen. But there are concrete steps that the provincial government, municipalities, and individuals can take to reduce Ontarians' vulnerability to floods. Actions fall into two broad categories:

- **Taking measures to better retain rainwater where it falls**, such as:
  - restoring and protecting wetlands and woodlands from development
  - installing raingardens, bioswales (channeled depressions containing vegetation and organic material) and green parking (lots with vegetation and trees)
  - increasing surface areas of pervious materials, while decreasing areas of impervious materials, and
  - disconnecting downspouts from buildings and houses so rain flows onto property instead of into the city's stormwater system.
- **Planning our infrastructure, buildings and communities to be more resilient to large amounts of stormwater**, such as:
  - requiring municipalities, working with conservation authorities, to regularly update and share floodplain maps
  - requiring municipalities to demonstrate that they have considered climate change implications in applications for new or amended Environmental Compliance Approvals for stormwater infrastructure, and
  - requiring municipalities to conduct climate change vulnerability assessments of their infrastructure as a condition of obtaining provincial government funding for projects.

Bio-filter swales absorb and clean stormwater before it enters a local creek in Brampton, Ontario.

Photo credit: Courtesy of Toronto and Region Conservation Authority (TRCA).

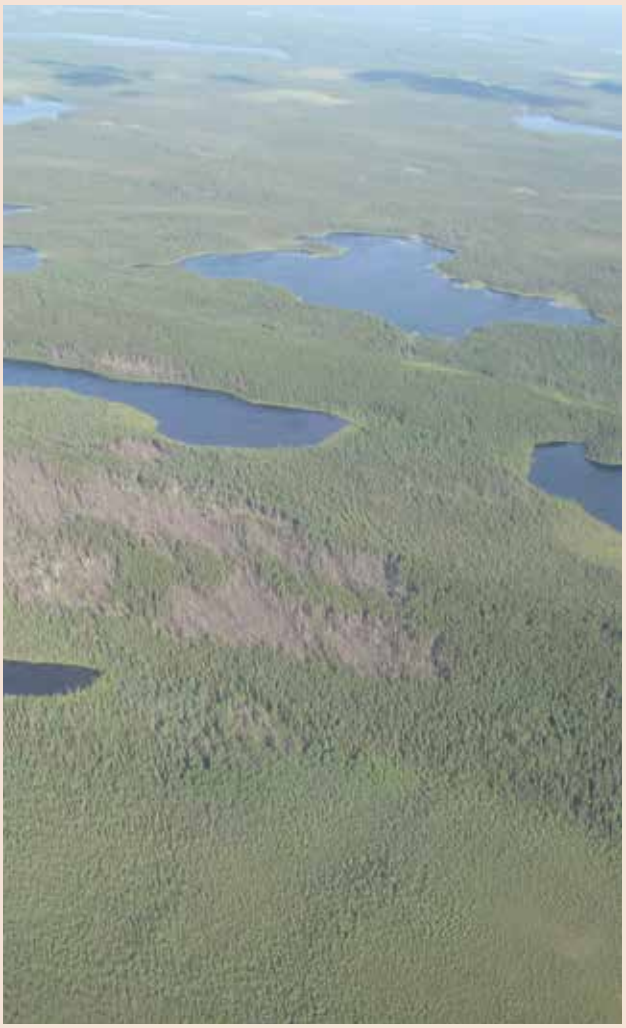
Preparing for climate-related forest impacts

Climate change is expected to have a number of ecological impacts on forests from increased minimum and maximum temperatures, and changing precipitation patterns.

To buffer the increased tree mortality expected to result from climate impacts (e.g., fire, insects and storm events), as well as the uncertainty in how different forests will respond to changing temperatures and precipitation, more forest area must be protected from human disturbance. Protecting the biodiversity of our forests at all scales (stand through to landscape) will give them the best chance to adapt to a rapidly changing climate.

Measures that Ontario can take to help our forests adapt to the changing climate include:

- increasing forest cover
- planning now for projected future forest conditions
- changing policy to enable assisted migration
- using more managed fire (see "Walking the Fire Line: Managing and Using Fire in Ontario's Northern Forests" in Volume 2 of the ECO's 2016 Environmental Protection Report)
- tackling the spread of invasive species (see "Invasive Species Management in Ontario: New Act, Little Action" in Volume 2 of the ECO's 2016 Environmental Protection Report), and
- changing policy to enable nimble, adaptive management for a range of possible outcomes.



Forest blowdown can occur during high winds and extreme weather events.

Photo credit: Ontario Ministry of Natural Resources and Forestry.

Preparing for climate-related stress on agriculture

Climate change may disrupt our ability to grow crops and raise animals in the ways we are used to.

There are many actions that farmers can take to prepare for and minimize the impacts of climate change on their farms and businesses. Ontario's Ministry of Agriculture, Food and Rural Affairs has a role in directing research and providing technical, financial and educational resources to help farmers make sound decisions for their agricultural businesses in light of climate risks and opportunities. Adaptation measures at the individual and government level could include:

- managing heat stress in livestock by maintaining sources of cool drinking water, providing shaded cover in pastures, and/or increasing air flow over animals with fans or reducing stocking density
- improving water management, such as replacing wasteful overhead systems with controlled, localized subsurface drip irrigation
- maximizing soil moisture retention through reduced tillage (mixing and aerating soil) techniques and maintaining hedgerows to reduce evaporation from wind and heat
- switching to crop varieties that are drought or heat tolerant
- improving knowledge, surveillance and evolving approaches to pest control, and
- ensuring that provincial business risk management programs, such as income stabilization for farmers and crop insurance for production loss related to adverse weather, pests, and other disasters, take climate change into account.

Drip irrigation (left) directly targets crops unlike conventional overhead crop irrigation systems (right) that result in water loss through evaporation.

Photo Credit: H. Gomez/CIMMYT (CC BY NC SA 2.0)/ USDA CC0).

There is a high cost to delaying action on climate change.

4.4 Pay now or pay more later

In Ontario's 2014 long-term report on the economy, the Ministry of Finance highlighted the need for prompt mitigation efforts, stating that "taking early action to reduce the emissions of GHGs will lower the overall cost of abatement and help Ontario achieve environmentally sustainable, long-term economic growth." Early action on mitigation should also keep adaptation costs in check. As noted in the United Kingdom-commissioned Stern Review on the Economics of Climate Change, as global temperatures rise, so will the costs of adaptation.

Studies in the United States, Australia and the United Kingdom (U.K.) have all found a return on investment for disaster risk reduction efforts. A recent U.S. study found that every $1 spent reducing the risk of future hazards saves the country $6 in future disaster costs. The previous Ontario government acknowledged that "it is more practical and less expensive to manage climate risks early than to react after the fact with disaster relief and rebuilding efforts."

The costs of climate inaction are not merely financial. Failure to adapt to climate change will leave Ontarians exposed to health and safety risks, including mental health impacts, and to potentially significant impacts on our day-to-day lives that go well beyond dollars and cents.

Early action is important – particularly for urgent risks. But it is also critical that adaptation measures be identified and considered strategically with other adaptation and mitigation efforts to avoid unanticipated outcomes. This will help ensure that measures taken are effective, for both impacts and costs.

But who will pay?

One of the reasons that governments have been slow to plan how to adapt to climate change is that the costs and losses could be enormous (for example, see Figure 1.10 in section 1.1.3 of this report), much larger than the $1 to $2 billion per year that the province was spending on reducing emissions.

The costs and losses could be enormous.

The long, painful isolation of Churchill, Manitoba, because no one wanted to pay the estimated tens of millions of dollars to repair the flood damage to its rail line – its only land link – is only one example of how debilitating adaptation and repair costs can be. Similarly, stormwater management is critical to reduce the increasing risk of flooding and other damage in urban areas due to climate change, but after decades of declining investment Ontario's municipalities face a staggering $6.8 billion stormwater infrastructure deficit. The Insurance Bureau of Canada (IBC) has been advocating for several years for improved infrastructure and flood risk mitigation by governments, along with stronger land use planning, building codes and public awareness to help improve community flood resiliency. The IBC is working with governments of all levels to improve awareness and specifically to address the financial management of flood risk for those properties at highest risk.

Photo credit: Toronto Hydro.

Flooding is not the only challenge. There is a wide range of things that should be done to prepare for other climate impacts, from installing air conditioning throughout transit systems and other public spaces to cope with higher temperatures, to replacing increasingly unreliable winter roads in the Far North with an all-season road network, to installing equipment on electricity distribution systems that is more resilient in the face of extreme heat and other climate impacts. Doing these things will be costly, and we don't know who will pay for them.

It is not reasonable to expect that the provincial government will pay all the costs that public and private property owners will incur to prepare for and recover from all manner of climate disasters. But it should lead an open conversation about the topic, so that everyone knows how much support they can and cannot expect.

4.5 Is Ontario getting ready?

The previous provincial government had acknowledged the need for Ontario to adapt to climate change for years. While progress has been made over the last decade, particularly by individual ministries such as the Ministry of Natural Resources and Forestry, the Ministry of Agriculture, Food and Rural Affairs, and the Ministry of Transportation, adaptation efforts have generally been piecemeal – built mostly on government actions that were already being planned or taken (see "Ontario's adaptation timeline," below, for a selection of Ontario's past adaptation efforts; for a more detailed summary of Ontario's adaptation work to date, see Appendix C). The former MOECC's lack of leadership and co-ordination has prevented Ontario from moving forward more effectively.

The provincial government has not undertaken a comprehensive climate change risk assessment.

A key barrier is the lack of systematic information about the province's vulnerabilities to climate change. A March 2018 report of provincial auditors general from across Canada, headed by the federal Commissioner of the Environment and Sustainable Development, asserted that climate change risk assessments are a "vital tool for informing adaptation strategies and action," and that "without a government-wide assessment, governments cannot prioritize and assign resources to manage risks efficiently." Comprehensive risk assessments can also provide a baseline for assessing the effectiveness of subsequent adaptation measures.

Assessments of some risks in Ontario have been undertaken at smaller scales (e.g., on a sector, regional or watershed basis). But the provincial government has not undertaken a comprehensive climate change risk assessment to identify the vulnerabilities and risks that most need to be addressed for Ontario as a whole.

There are other gaps in our knowledge that also urgently need to be filled, to identify the best ways to respond to and prepare for specific climate impacts, and to understand the potential limits of adaptation measures and how they may interact with other adaptation and mitigation efforts.

Ontario's adaptation timeline

A selection of government adaptation initiatives

Major government initiative | Ministry policy or plan | Legislation

2007

Expert Panel on Climate Change Adaptation

- Panel established "to help the Ontario government, municipalities and Ontarians prepare for the impact of climate change in areas such as public health, environment, infrastructure and the economy"

2008

Lake Simcoe Protection Act, 2008

- One objective of the act is to to improve the Lake Simcoe watershed's capacity to adapt to climate change

2009

Expert Panel Report

- Notes "clear need" for a comprehensive strategy to reduce the present and future impacts of climate change
- Makes 59 recommendations, including the launch of a province-wide climate change adaptation action plan
- Warns against "[p]iecemeal, uncoordinated action"

2010

Far North Act, 2010

- Enables the issuance of Far North policy statements related to ecological systems, processes and functions, including considerations for climate change adaptation

2011

Climate Ready: Ontario's Adaptation Strategy and Action Plan 2011-2014

- Based on five strategic goals
- Includes 37 actions across ministries
- The ECO critiqued the plan as "an inventory of Ontario government actions rather than a strategic plan"
- No targets or timelines

2014

Provincial Policy Statement 2014

- Includes direction for planning authorities to support climate change adaptation through land use development patterns and to consider the impacts of climate change in infrastructure planning

2015

Climate Change Strategy

- Focus on greenhouse gas reductions and transitioning to a low-carbon economy
- Strategy includes one part on Adaptation and Risk Awareness

2016

Climate Change Action Plan

- Five-year action plan (2016-2020)
- Focus on greenhouse gas reductions (mitigation)
- Promised a new adaptation plan in 2017

Pan-Canadian Framework on Growth and Climate Change

- Collaborative plan between provinces and federal government to reduce emissions of greenhouse gases, build climate resilience and grow a clean economy
- Identifies actions to support adaptation across Canada in 5 priority areas
- Established a Canadian Centre for Climate Services in 2018

Infrastructure for Jobs and Prosperity Act, 2015

- Requires the government and every broader public sector entity to consider the principle that "infrastructure should be designed to be resilient to the effects of climate change"

Ontario Climate Change and Health Toolkit

- Helps local public health units identify vulnerabilities in their communities, develop adaptation and mitigation strategies, and raise awareness about the health impacts of climate change

4

2017

Lake Simcoe Climate Change Adaptation Strategy

- Purpose is to “facilitate climate change adaptation within the Lake Simcoe watershed to ensure that the long-term health of Lake Simcoe is restored and protected now and in the future"

Municipal Act amendments

- Enables local municipalities to pass bylaws requiring construction of green roofs

Growth Plan for the Greater Golden Horseshoe, 2017

- Requires municipalities to develop policies and identify actions in their official plans that will address adaptation goals

Ontario's Long-Term Energy Plan

- Commits to better preparing Ontario’s energy systems for extreme weather events

Naturally Resilient

- Natural Resource Climate Adaptation Strategy (2017-2021)
- 5-year framework to help address climate change vulnerabilities and support climate change adaptation efforts across ministry policy, science, operations and service delivery

New Approach to Adaptation

Proposed approach includes:

- A new governance framework that supports a government-wide approach to adaptation
- A new climate change adaptation organization
- A province-wide risk assessment of climate impacts
- Raising public awareness about the effects of climate change

Ontario's Long-Term Infrastructure Plan

- Outlines efforts that the province will lead to make infrastructure more adaptable and resilient to climate change

Conservation Authorities Act amendments

- Allow for regulations that establish standards and requirements for programs and services to mitigate the impacts of climate change and provide for adaptation to a changing climate (amendments not yet in force)

Planning Act amendments

- Makes adaptation to climate change a provincial interest for planning purposes
- Requires municipal official plans to contain policies that provide for adaptation

Considering climate change in the environmental assessment process

- Outlines ways that proponents of projects subject to environmental assessment processes can incorporate climate change impacts considerations

2018

Agricultural Soil Health and Conservation Strategy

- Identifies risks to soil and crops under a changing climate
- Promotes soil health practices to improve resilience to extreme weather

Spring 2018

- New approach but no new adaptation action plan
- Governance framework for adaptation unknown
- New climate organization in development
- Province-wide Risk Assessment planning underway

A promising new approach

In late 2017, under the previous provincial government, the MOECC embarked on a more strategic approach to adaptation – one that could set Ontario on a more promising course to climate resilience. Ministry staff explained to the ECO that the new approach would enable the ministry to take a step back from its previous piecemeal efforts at adaptation planning, and lay a stronger foundation to support more strategic, co-ordinated action going forward.

It is unclear what, if anything, the new provincial government will do to prepare Ontario for climate impacts.

The approach included four parts (described in more detail, below):

1. A new climate change adaptation organization
2. A province-wide risk assessment of climate impacts
3. A new governance framework that supports a government-wide approach to adaptation
4. Raising public awareness about the effects of climate change

It is unclear what, if anything, the new provincial government will do to prepare Ontario for climate impacts. In August 2018, MECP staff told the ECO, "at this time we are not aware of the current government's direction on climate change adaptation."

1. A new climate change organization

The MOECC proposed creating a new organization to provide leading-edge information and services related to climate change adaptation. The organization would be independent and not-for-profit, funded primarily through provincial transfer payments. Partnerships, in-kind contributions and fees for service are expected to partially offset operational costs.

The organization would serve three main purposes.

1. **Provide climate science and information**, as a one-window source of information about climate change impacts. The organization would work with experts to consolidate and improve available climate projection data and information about climate change impacts, and make it available to users. It could also step in to fill any identified information gaps.
2. **Assist users with adaptation planning and solutions**, by undertaking risk and opportunity assessments, and conducting demonstration and pilot projects. It would provide direct programming to those communities with limited capacity and resources to address climate risks on their own.
3. **Assist with capacity building, engagement and public awareness**, through case studies, training, workshops, webinars and tutorials for adaptation planning. The organization would also undertake education and outreach efforts to build public awareness of the risks of climate change.

The organization's data, analysis, services and programs would be open to everyone across the province, but likely users of the organization would include: provincial ministries and agencies; municipalities; conservation authorities; Indigenous communities; agricultural and resource sectors; and the private sector (e.g., insurance and financial services). A similar organization in Quebec, Ouranos, has been fulfilling these functions successfully for some years.

The Canadian Centre for Climate Services, an organization established in 2018 as part of the Pan-Canadian Framework, will act as the official source of climate information, data and tools from the federal government. The Canadian Centre for Climate Services is intended to work with regional climate organizations, or "hubs," to provide regionally relevant services. Ontario's new climate change organization would be one such hub.

The new organization cannot begin work without provincial funding.

The new organization was incorporated in June 2018, but cannot begin work without provincial funding.

2. A province-wide risk assessment of climate impacts

Under the previous government, the MOECC proposed undertaking the first ever comprehensive, province-wide climate change risk assessment, to provide a better understanding of the current and projected impacts of climate change facing Ontario, and the extent and likelihood of the risks associated with those impacts.

Following the approach taken in the U.K.'s national risk assessments (see section 2.1 of this report), this risk assessment would identify current climate change impacts, vulnerabilities, risks and opportunities in the province, as well as those projected for the 2030s, 2050s and 2080s. The provincial risk assessment would also include evaluations at regional and local scales, and in areas identified as requiring more detailed assessments.

The provincial climate change risk assessment, if carried out, would set out a framework for prioritizing climate risks and guiding adaptation decisions. The framework would also consider how future costs and benefits of adaptation should be incorporated into decision making. The risk assessment would focus on the following core themes:

- public assets and infrastructure
- public health, safety and well-being
- agriculture and food
- the natural environment
- economic, financial and business services, and
- Indigenous communities.

Rather than duplicate existing work, the provincial climate change risk assessment would build on and complement existing climate change research and assessment of impacts, and identify gaps and information that need updating. Provincial government decision-makers would use the provincial climate change risk assessment to prioritize adaptation action and allocation of resources. It would also assist municipalities, Indigenous communities and the private sector in identifying areas in need for further assessment, and in developing their own climate change adaptation strategies.

The provincial climate change risk assessment would not be completed until at least March 2021, but progress reports would be required each quarter. As of spring 2018, the ministry was well into the process of procuring services to undertake Ontario's provincial climate change risk assessment, but little has happened since then.

3. A new governance framework that supports a government-wide approach to adaptation

Acknowledging that no single ministry can be responsible for addressing climate change, the MOECC stated that it was "working towards developing a more strategic and co-ordinated whole-of-government approach to managing climate change risks." This involves making adaptation part of day-to-day government operations and decision-making. The March 2018 report of Canadian provincial auditors general noted that "without effective coordination [among government departments and agencies], government responses to climate change may be ad hoc and inefficient."

The MOECC identified three key elements of an all-of-government approach:

1. General oversight for integrating adaptation into government decision making, enabled by a lead ministry, central agency, and/or legislation

2. Enabling policy (e.g., an adaptation strategy, action plan and/or program), and
3. Potential tools to facilitate the process (e.g., the new climate change organization; budget mechanisms).

> "Without effective coordination, government responses to climate change may be ad hoc and inefficient."
>
> Canadian provincial Auditors General

Unfortunately, this critical aspect of the proposed approach to adaptation remains in very early stages. In March 2018, the then MOECC told the ECO that it was still in discussions with partner ministries about developing "a strong governance framework to ensure all-of-government co-ordination to more effectively identify priorities and implement climate change adaptation actions." However, as of August 2018 no decisions had been made or further action taken.

4. Raising public awareness about the effects of climate change

The final component of the proposed new approach to climate change adaptation is about sharing information about the effects of climate change with the public. The goal is "to encourage each person, each community and each sector to understand the importance of preparing and acting."

Under the MOECC's proposed approach, the new climate change organization would play an important role in building awareness and encouraging action, in particular by providing Ontarians with local information about climate impacts to give them a better understanding of how climate change affects them.

4.6 Vulnerabilities, data and incentives

The previous provincial government acknowledged that "government leadership on climate change adaptation is critical for the future financial and economic well-being of our province." The current Ontario government should take on this leadership role, and provide planning, co-ordination and oversight to support actions across the province to help prepare for climate disruption.

Many actions can only be carried out by provincial government ministries and agencies. To enable such actions, the government should prioritize the development and implementation of a provincial adaptation plan with specific, measurable, time-bound actions with clearly identified responsibilities. As part of this plan, the provincial government should continue to mainstream adaptation across government by integrating strong and specific direction on climate change adaptation into laws, policies and standards. A measurement and evaluation program to make sure that government's adaptation actions are working, as well as reporting obligations to keep the public informed, are key aspects of good planning.

In Ontario, a governance framework supported by legislation, similar to that in the UK (see section 2.1 of this report), could help ensure that the provincial government follows a regular cycle of adaptation planning, implementation and reporting, and that the MECP (or other oversight body) has the necessary authority to require action from other ministries. The MECP should also commit to publishing regular updates on the Environmental Registry to inform the public of its progress on adaptation, the status of climate change impacts in Ontario, and, more generally, how well Ontario is adapting to those impacts and what more needs to be done.

To effectively carry out its leadership role on climate change adaptation, the Ontario government urgently needs to take the actions discussed below.

Ontario needs to know what our vulnerabilities are.

Identify Ontario's vulnerabilities to climate change, and priorities for action

As discussed in section 4.5, Ontario needs to know what our vulnerabilities are in order to effectively manage the risks that come with climate change.

A province-wide risk assessment is necessary to identify current and anticipated impacts of climate change, and to determine the scope of Ontario's vulnerabilities to those impacts. This would allow the province to identify the risks that must be acted on most urgently, and, in turn, develop an adaptation plan that is more strategic than past efforts. The MECP should proceed immediately with the planned province-wide climate change risk assessment, so that it can inform strategic adaptation planning in Ontario.

It is, of course, essential for Ontario to identify vulnerabilities of its physical infrastructure. However, the other financial impacts of climate change may dwarf those of infrastructure damage. U.S. studies suggest that the combined value of market and nonmarket damage across agriculture, crime, coastal storms, energy, human mortality, and labour will cost roughly 1.2% of gross domestic product per +1°C of additional average temperature.

Financial impacts of climate change may dwarf those of infrastructure damage.

To help prioritize action, Ontario's vulnerability assessment should therefore estimate the economic cost of climate change, by decade, including impacts on:

1. health care of heat exhaustion, climate related diseases, wildfires, poorer air quality, and the risk of increased antibiotic resistance, as well as the increased cost of air conditioning
2. changes in precipitation and temperature on drinking water supplies, sewage treatment, stormwater management and hydro-electric production
3. agriculture and on the cost and availability of food of longer growing seasons, increased average temperature, greater variability of precipitation and more frequent extreme events, as well as invasive species
4. forest health and on forestry of increased wind, drought, heat and fire, as well as invasive species
5. education and transit of the increased cost of air conditioning
6. the cost and availability of insurance for increased extreme events
7. business productivity of higher average temperatures and more extreme events
8. Ontario businesses of climate-related disruption to supply chains from outside Ontario
9. tourism of less reliable snow and ice
10. tourism and on fisheries of warmer, more acidic lakes and rivers with less oxygen in the water
11. northern communities of loss of ice roads and permafrost
12. Ontario pension funds, including the risk that fossil fuel assets will be stranded or of less value
13. municipal budgets
14. the provincial government's expenditures to fight fires and floods and compensate public and private sector businesses and property owners for climate-related damages, and
15. provincial government tax collections, expenditures, and debt.

At the request of the federal Treasury Board, the independent, not for profit Council of Canadian Academies has convened a volunteer Expert Panel on Prioritizing Climate Change Risks with the following mandate: "What are the top climate change risks facing both Canada and the federal government, and their relative significance, and which have the most potential to be minimized by adaptation measures?" The Panel's report is expected to be delivered late in the spring of 2019. The Panel will base its assessments of damages on data provided by the Canada Centre for Climate Modelling and Analysis at the University of Victoria, and on a range of scenarios informed by recent science of the risks ahead. Ontario should co-ordinate its vulnerability assessment with the Expert Panel on Prioritizing Climate Change Risks.

Protecting natural heritage areas should be a key priority

While more information about Ontario's climate vulnerabilities and risks will help the province develop a more strategic course of action, we already know that protecting natural heritage is critically important to making Ontario more resilient to climate change. The provincial government should:

1. Grow Ontario's protected areas, and
2. Enhance protection of wetlands, woodlands and other natural heritage features that buffer climate extremes.

Grow Ontario's protected areas

As the ECO reported in our 2017 Environmental Protection Report, climate change is one of the major pressures on Ontario's biodiversity. Protecting the very ecosystems that we – and all of Ontario's species – depend on has never been more important. Protected areas like provincial parks and conservation reserves provide habitat for wildlife and species at risk, and are instrumental in maintaining ecosystem services like clean air and water. Although protected areas will be significantly affected by climate change, they offer the potential to play an important role in climate change adaptation.

As the climate changes, many species will be forced to move into new areas in order to survive. But most species will not be able to make this geographic shift unless there are adequate connections between natural landscapes. Protected areas can play a key role in acting as migration corridors. Ensuring that adequate, protected migration corridors exist will be critical in preventing major extinctions.

We already know that protecting natural heritage is critically important to making Ontario more resilient to climate change.

Beyond supporting connectivity at a landscape level, protected areas can sometimes be used to conserve areas that species will be able to retreat to and persist in under future climate conditions (known as climate refugia). In our 2017 Environmental Protection Report, we recommended that the government develop a strategic plan for how it will protect at least 17% of the province, including protecting climate refugia (see Chapter 6 of the ECO's 2017 Environmental Protection Report).

Enhance protection of wetlands, woodlands and other natural heritage features

Protecting natural heritage features may also lessen the negative effects of climate change.

For example, conserving wetlands is a widely recognized and effective mechanism for helping to control the effects of extreme weather like floods. Wetlands can also reduce drought impacts by

acting like sponges during wet periods and gradually recharging groundwater as water levels fall, which helps to replenish surrounding soils and streams. As climate change progresses, viable habitats for species at risk can become scarce or degraded, and it is increasingly important that features such as wetlands are preserved across landscapes to reduce biodiversity losses.

Woodlands and trees are also indispensable for climate change adaptation. In urban areas, they are "green infrastructure" that provides us with essential services: they filter air pollution, retain and filter stormwater, and mitigate the increasingly extreme heat island effect. Forests within and outside our urban centres also provide all of these services while enhancing soil biodiversity, providing habitat for pollinators, helping prevent erosion, and mitigating drought. They cushion the effects of warming temperatures and changing precipitation patterns by retaining moisture, filtering increased stormwater, cooling the area around them, and providing refuge for species stressed by the rapidly changing conditions.

In the ECO's 2018 Environmental Protection Report, the ECO will provide a more in-depth examination of why southern Ontario continues to lose wetlands and woodlands, and what the provincial government needs to do to better protect these natural heritage features.

4

Protecting natural heritage features may also lessen the negative effects of climate change.

Photo credit: Ducks Unlimited Canada.

Provide consistent and accessible data and information on the future climate

To adapt to the changing climate, Ontario's communities and businesses need reliable information about what the future climate will look like, and guidance on how to use that information. The provincial government should ensure the availability of high-quality climate data, including modelling and projections, that is critical to adaptation planning.

Ontario's communities and businesses need reliable information about what the future climate will look like.

There is a wealth of climate data available in Ontario from multiple sources, including the provincial government. However, the world of climate data can be challenging to navigate. As the ECO learned from stakeholder participants at our 2015 roundtable on climate data, some datasets are difficult to interpret, or are not available in user-friendly formats. There may be data gaps, or limitations on its usefulness. In cases of overlapping datasets, users may be uncertain about which dataset to use; the lack of standardization or accreditation of climate data make it difficult to judge how reliable a particular dataset may be. Add to these challenges the varying levels of sophistication of different types of climate data users, and the need for provincial guidance and support on climate data is clear.

The creation of a new, independent organization to act as a one-stop source for reliable climate data projections, and to fill in data gaps, is a promising step. By helping to identify the appropriate information on which to base adaptation action, removing uncertainty about the reliability of climate data, and filling in any data gaps, the organization should remove potential barriers to adaptation action for many users.

The organization should also ensure that the climate data used to support government decision-making on adaptation measures is accessible to the public, creating greater transparency and accountability. The MECP should ensure the new climate organization receives the necessary funding to provide reliable climate data and support climate change adaptation efforts across the province.

Incent Ontarians to increase their own resilience

Ontario's Climate Change Action Plan, which focused on climate change mitigation, set out numerous incentives for homeowners to cut emissions and promote energy efficiency. Similar types of incentives could be used to support adaptation efforts, such as flood-proofing homes and buildings, planting trees, or installing water conservation measures like low-flush toilets.

The ECO has previously recommended that the government support municipalities in implementing stormwater fees as an incentive to make properties and communities more resilient to climate-related flooding (see the ECO's 2016 report, Urban Stormwater Fees: How to Pay for What We Need). To recover the costs they must spend managing stormwater, municipalities can charge property owners fees based on the amount of impervious surfaces (i.e., surfaces that do not absorb water, and lead to runoff) on their properties. Stormwater fees calculated in this way would provide a strong incentive for both public and private property owners to limit the stormwater runoff from their properties (for example, through green infrastructure, rain gardens, or by using permeable pavement), and help communities cope with more intense rainfall events associated with climate change. The Cities of Kitchener and Mississauga both successfully fund stormwater management through stormwater fees, but provincial guidance and support is needed to promote more widespread use of this approach.

The government should create incentive programs to encourage homeowners, businesses and others to minimize climate risks to themselves and others.

4.7 Ontario needs strong leadership on adaptation, now

It is time for the Ontario government to take climate change adaptation seriously.

It is time for the Ontario government to take climate change adaptation seriously.

4

Climate change adaptation is not just about the environment. It's about people, too. It's about protecting our homes, our communities and our way of life as much as possible from changes to the world around us, and about finding ways to make the best of those changes.

It's too late to stop some climate change from happening, so we need to be as prepared as we can to deal with its impacts. In Ontario, we are already feeling, and paying for, the effects of our changing climate. We need urgent action to protect our families, our health, our environment, our economy. Failure to act now will be costly.

The provincial government must play a leadership role in making Ontario resilient to climate change, by ensuring that ministries across government are taking action, and ensuring that municipalities, businesses and individuals have the necessary information and support to do their part.

To carry out this leadership role, Ontario urgently needs to:

- ensure that the province's vulnerabilities and risks to climate change are identified, and that adaptation priorities are identified and addressed first
- provide users with consistent and accessible data and information on the future climate, so they know what to prepare for, and
- incent Ontarians to increase their own resilience to what's ahead.

Just as important, Ontario needs to start an open conversation about who is going to pay for adaptation.

Ontario has lost a decade to unco-ordinated efforts and sluggish action on adaptation. The provincial government must not waste another decade half-heartedly talking about and planning for adaptation, but not doing enough. How many floods, droughts, heat waves and ice storms will we experience during that time? How much damage to property and infrastructure? How many heat-related deaths? How many species lost?

It's too late to stop some climate change from happening.

Climate change is a defining issue of our time; it will change the course of Ontario's future. The provincial government has a responsibility not only to reduce our GHG emissions, which are causing the climate to change, but to ensure that Ontario is as prepared as it can be to face the changes that are coming. The government must pursue strong action on mitigation and adaptation together, to give Ontario the bright future it deserves.

4.8 Recommendations

To reduce the cost of future climate impacts, the Ontario government should:

- fund the new climate data organization, so that it may provide Ontarians with reliable data on the climate that is coming

Climate change will change Ontario's future.

- assess and prioritize Ontario's physical and financial vulnerabilities to climate risk
- clarify who is responsible for which adaptation tasks, and by when
- create incentives that encourage homeowners, businesses and others to reduce climate risks to themselves and others, and
- integrate preparing for climate risks into provincial laws, policies and standards.

Part 5:
Recommendations

5

A framework for Ontario

5

Climate change is a clear and present danger. It threatens Ontario's natural environment, human health and safety, and economic productivity. To protect our way of life, it is the provincial government's responsibility to adopt laws and policies that will reduce Ontario's greenhouse gas emissions and prepare the province and its people for what's to come.

Taking action on climate change will not be cheap, but the costs of delay and inaction will be far greater – and Ontario risks losing out on other benefits of climate action, such as cleaner air, lower health costs and good jobs.

The sooner we act, the easier and less costly it will be. Ontarians need to pull together and protect what we value. Government must provide leadership and be clear about the tough decisions, and opportunities, ahead of us. There are many tried and tested policy options available.

The ECO recommends that the provincial government develop a climate framework with the following central features:

1. Commit: targets and law

a. A climate law that commits the provincial government to a credible, long-term program to achieve statutory emission reductions that:
   i. meets Ontario's fair share of Canada's emission reduction obligations and creates good jobs (sections 1.5 and 3.1), and
   ii. meets the requirements of the Pan-Canadian Framework to unlock federal funds (section 3.3).

b. Legally binding carbon budgets set well in advance, based on non-partisan, expert advice, coupled with rigorous progress reporting and independent evaluation (section 2.1).

c. Provincial leadership on adaptation and preservation of natural areas (Part 4).

2. Plan a pathway

a. A transparent, achievable, cost-effective pathway to each carbon budget. The model described in this report is a good start. Note: The lowest-cost pathways require much more clean electricity and storage than the current Long-Term Energy Plan will provide (section 3.1).

3. Take action

a. Effective policy tools to achieve the necessary emission reductions, using the lowest-cost pathway, public health and ecological integrity to choose priorities. Appendix A contains a convenient menu of the potential tools discussed in this report.

b. Act fast and take advantage of work already done, here and elsewhere. Ontario is not starting from scratch and does not need to reinvent the wheel. Build on the best of the previous programs. Emphasize efficiency first (e.g., in social housing, schools, hospitals) (section 1.3, Appendix B).

c. Minimize disruption from the cancellation of previous programs (section 1.4).

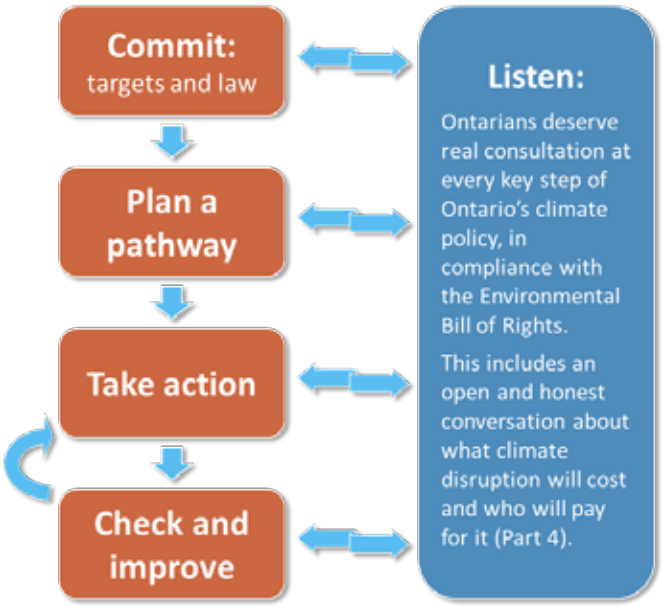
4. Check and improve

a. Monitor and report progress to the public, with third-party validation (section 2.2).

b. Revise plan and actions as needed to stay on track for targets (section 2.2).

Listen

At each stage, it is essential to listen to Ontarians. Ontarians deserve a real consultation, in compliance with the *Environmental Bill of Rights*, on every key step of Ontario climate policy. This includes having an open and honest conversation about what climate disruption will cost and who will pay for it (Part 4). Climate policy is too important to be decided behind closed doors, without telling Ontarians what is planned or hearing what they have to say (section 2.2).



Bill 4, the proposed *Cap and Trade Cancellation Act, 2018*, currently lacks most of the features of a good climate law.

Detailed recommendations

With these overall requirements in mind, the ECO recommends the following.

Commitment and credibility (Part 2)

To attract talent and investment, and to maximize the chance that its climate policies will be effective and will survive changes in government, the Ontario government should model its climate law on the U.K. *Climate Change Act*, including:

- statutory emission limits
- legally binding multi-year carbon budgets set 12 years in advance, which apply to the entire term of a single government

- a non-partisan, expert advisory committee with permanent staff to provide reliable advice, and to recommend carbon budgets that will meet the statutory emission limits
- regular government reports on its progress towards meeting the budgets and targets, which are publicly evaluated by the advisory committee, and
- requiring essential service providers to prepare for climate risks.

Ontario should also adopt, as far as possible, the Nordic approach of seeking common ground across party lines, and of each parliamentarian accepting individual responsibility for his or her own climate leadership.

To build good solutions that the public can support, the government should respect its obligations and the rights of Ontarians under the *Environmental Bill of Rights*, and provide real public consultation on Ontario's legislation and action plans on emission reductions and on climate adaptation.

Reducing emissions (Part 3)

The least-cost pathway (section 3.1)

To minimize the cost of reducing emissions, the Ontario government should:

- significantly increase Ontario's clean electricity supply, and reduce demand, by:
  - more aggressive energy efficiency and conservation across the economy
  - expanding non-emitting electricity sources (e.g., hydropower, wind, solar, nuclear) and storage (the government should therefore reconsider the 752 renewable energy contracts that it cancelled)
  - expanding electricity interconnections with Quebec to allow for increased clean power imports, and
  - enhancing the uptake of electric vehicles that are charged off-peak.
- prepare to:
  - remove most fossil fuels from transportation in Ontario
  - remove most natural gas from water and space heating in buildings, and
  - minimize fossil fuel use in Ontario industries.
- invest in new emissions reduction technologies, including carbon capture and storage, and ways to accumulate and store carbon in natural systems.

The three-legged stool (section 3.2)

To drive down emissions and stay within its carbon budget, the Ontario government should:

- take advantage of the power of the polluter-pay principle
- unlock funds for the low-carbon solutions that Ontario needs, and
- regulate climate pollution.

Making polluters pay (section 3.3)

To give climate polluters incentives and rewards for reducing their emissions, the Ontario government should:

- put a price, directly or indirectly, on climate pollution.

Finding ways to pay for solutions (section 3.4)

To unlock funds for the low-carbon investments needed in Ontario, the government should:

- make the best possible use of remaining cap and trade funds
- qualify for federal low-carbon funding, by complying with the Pan-Canadian Framework
- phase out inefficient and wasteful fossil fuel subsidies
- expand utility conservation programs

- use public sector procurement to lead by example and support Ontario's cleantech sector
- require financial disclosure of climate risk for all entities regulated by the Ontario Securities Commission
- create a revolving loan fund to provide capital for energy efficiency, fuel switching and clean technology, and
- conduct a review of Greenhouse Gas Reduction Account initiatives in a timely and transparent manner, and continue to fund valuable and effective projects.

Regulating climate polluters (section 3.5)

To ensure Ontario achieves the emission reductions that are necessary to minimize climate disruption, the Ontario government should:

- adopt a stringent clean electricity standard to prevent natural gas electricity emissions from increasing
- use a zero emission vehicle standard and/or feebate system to increase the uptake of new, cleaner vehicles
- set a vehicle emission pollution limit to eliminate highest emission vehicles and protect public health
- ensure the Growth Plan for the Greater Golden Horseshoe effectively reduces the need for fossil fuels
- strengthen the Ontario Building Code for new and existing buildings to enhance energy efficiency and reduce GHG emissions
- continue to require increased reporting of building energy use, leading to more competition in public and commercial spaces as well as homes
- ban organic waste from landfills to reduce landfill gas emissions, and
- use extended producer responsibility requirements to reduce non-organic waste.

A good climate policy considers the specific circumstances of each sector. Section 3.6 and Appendix A contains some examples of sector-specific recommendations.

Getting ready for what's coming (Part 4)

A stitch in time saves nine. To reduce the cost of future climate impacts, the Ontario government should:

- fund the new climate data organization, so that it may provide Ontarians with reliable data on the climate that is coming
- assess and prioritize Ontario's physical and financial vulnerabilities to climate risk
- clarify who is responsible for which adaptation tasks, and by when
- create incentives that encourage homeowners, businesses and others to reduce climate risks to themselves and others, and
- integrate preparing for climate risks into provincial laws, policies and standards.

Appendix A: Policy tools to fight climate change

Abstract

There is no single fix for climate change, and the government will need to employ many different policy tools to play its part in addressing this enormous challenge. The ECO has reported on several policy options in this and past reports and compiled some key climate change mitigation and adaptation tools here.

Contents

A1 Climate change mitigation policy tools

Part 3 of this report discusses the types of tools that governments can use to drive down greenhouse gas emissions. It describes the three-legged stool of possible policy options, but is not a comprehensive list. Additional tools are also discussed in recent ECO reports, including our annual greenhouse gas progress reports and our:

- 2015/2016 Energy Conservation Progress Report, Let's Get Serious, which discusses transportation (Chapter 3) and building sector policies (Chapter 4 and 5)
- 2016 report, How to Pay for What we Need, which focuses on stormwater infrastructure
- 2016/2017 Energy Conservation Progress Report, Every Drop Counts, which addresses municipal water and wastewater systems
- 2017 Special Report, Beyond the Blue Box, which addresses waste sector policies, and
- 2018 Energy Conservation Progress Report, Making Connections, which examines electricity sector policies (Q16, Q17 and Q19).

Table A.1 below provides a convenient table of key policy options discussed in this report as well as some recent ECO reports.

Table A.1. Examples of climate change mitigation policy options discussed in Part 3 and previous ECO reports.

	MAKING POLLUTERS PAY	INVESTING IN SOLUTIONS	REGULATING CLIMATE POLLUTERS
CROSS SECTOR	• Price on greenhouse gas emissions • Price on emissions with high global warming potential • Remove fossil fuel subsidies	• Research and development into low-emission technology • Loan guarantees/low-interest loans for low-carbon investments • Low-carbon procurement	• Climate-related financial risk disclosure • Removing barriers to low-carbon investment financing • Public sector energy use/emissions reporting
TRANSPORTATION SECTOR	• Gasoline and diesel tax • High-emission vehicle fee • Vehicle registration fees • Road pricing (e.g., tolls, congestion charges)	• Zero emission vehicle rebate • High-emission vehicle scrappage incentive • Infrastructure funding for electric vehicle charging • Public transit funding • Active transportation infrastructure funding • Tying infrastructure funding to municipal land use planning results	• Zero emission vehicle standard • Charging infrastructure in building codes • Vehicle pollution limits • Fuel emission standards • Enforcement of transit-supportive land use plans • Streamlining of approvals to meet density targets • Giving transit vehicles priority on major roads
BUILDINGS SECTOR	• Natural gas tax	• Natural gas conservation rebates • Fuel switching rebates • Energy efficiency retrofit funding	• Update building code for new and renovated buildings • Home and large building energy use disclosure • Improve performance standards for equipment • Renewable natural gas content requirements
ELECTRICITY SECTOR	• Enhanced time-of-use electricity pricing with higher on-peak rates	• Enhanced time-of-use electricity pricing with lower off-peak rates • Electricity conservation rebates • Renewable energy and storage project funding	• Clean electricity standard • Net and virtual net metering • Enable utilities to recoup investment/innovation costs • Ensure Market Renewal policies properly value non-emitting sources
WASTE SECTOR	• Extended producer responsibility • Higher fees on landfill disposal	• Landfill gas and biogas energy production project funding • Procurement of products containing recycled material	• Organic waste landfill ban • Waste diversion requirements • Streamlining organic waste facility approvals • Extended producer responsibility

A2 Climate change adaptation policy tools

Part 4 of this report (and Table A.2 below) describe some key steps that the provincial government can take to prepare and adapt Ontario for a changing climate. Again, this is not a comprehensive list but an illustration of some available options.

Table A.2. Examples of climate change adaptation policy options discussed in Part 4 and previous ECO reports.

HEALTH AND SAFETY	• Update building codes to require that buildings be constructed or retrofitted to withstand future climatic conditions • Develop early warning systems for extreme weather events • Include potential climate impacts in disaster management planning • Provide cooling and warming shelters for the public • Use light-coloured pavement and roofing materials (to reflect heat) • Increase the urban tree canopy (to create more shaded areas and cool the air) • Educate the public about how to protect against health impacts, such as heat-related illness and exposure to climate-sensitive diseases
FLOODING	• Preserve wetlands, woodlands and other natural features to help absorb rainwater/snowmelt and reduce stormwater runoff • Build and update roads and bridges to withstand more frequent freeze-thaw cycles and more intense rainfall events • Encourage the installation of raingardens, bioswales (channeled depressions containing vegetation and organic material) and green parking (lots with vegetation and trees) • Increase the use of permeable materials for surface areas, and decrease the use of impermeable materials • Encourage the disconnecting of downspouts from buildings and houses so rain flows onto properties instead of into stormwater systems • Require conservation authorities and municipalities to regularly update and share floodplain maps • Require municipalities to consider climate change implications in applications for new or amended approvals for stormwater infrastructure • Require municipalities to conduct climate change vulnerability assessments of their infrastructure as a condition of obtaining provincial government funding for projects
FORESTS AND BIODIVERSITY	• Create new protected areas to account for potential impacts on biodiversity • Increase forest cover • Plan for projected future forest conditions, and enable nimble, adaptive management for a range of possible outcomes • Enable assisted migration of trees and plants • Use more managed fire solutions, including prescribed burns and allowing naturally occurring fires to burn when safe and appropriate • Minimize the spread of invasive species
AGRICULTURE	• Publish agricultural best management practices to help farmers avoid crop damage or loss due to changing growing conditions • Manage heat stress in livestock by reducing stocking density and providing cool drinking water, shaded cover in pastures, and fans to increase air flow • Improve water management, such as replacing wasteful overhead systems with controlled, localized subsurface drip irrigation • Maximize soil moisture retention through reducing tillage (mixing and aerating soil) techniques and maintaining hedgerows to reduce evaporation from wind and heat • Encourage farmers to switch to drought- or heat-tolerant crops, where appropriate • Improve knowledge and evolving approaches to pest control • Ensure that provincial business risk management programs are well designed and effective

The government raised $2.9 billion from cap and trade to fund mitigation programs across Ontario.

The sudden cancellation of these programs may have far-reaching social, environmental and economic impacts.

Appendix B: Revenue from cap and trade: what was it used for?

Abstract

Ontario's cap and trade program raised $2.9 billion in revenues, which were tracked in the Greenhouse Gas Reduction Account. These revenues funded a wide range of initiatives to reduce greenhouse gas emissions, supporting hundreds of recipients across Ontario, including schools, hospitals, small businesses, municipalities and social housing providers. Some of these programs were already beginning to show progress, although it is likely too early to determine what level of greenhouse gas reductions they will achieve.

In June 2018, the government announced it was cancelling cap and trade and all associated initiatives, including the Greenhouse Gas Reduction Account. This will have a range of implications, including higher greenhouse gas emissions than were projected; cancellations of projects that were underway, many of which had leveraged additional funding from other levels of government or the private sector; and the loss of a dedicated funding source to support Ontario's climate change goals.

Contents

B1 Overview of cap and trade spending

B1.1 How much went in and out of the Greenhouse Gas Reduction Account?

Since January 2017, cap and trade raised almost $2.9 billion in government revenues from six auctions - $2.4 billion up to March 31, 2018, and $472 million in the final May 2018 joint auction with California and Quebec (see section 1.3 and figure B.1). Under the *Climate Change Mitigation and Low-carbon Economy Act, 2016* (*Climate Act*), these revenues were recorded in a public account called the Greenhouse Gas Reduction Account (GGRA), and used to "fund, directly or indirectly, costs relating to initiatives … that are reasonably likely to reduce, or support the reduction of, greenhouse gas."

As of March 31, 2018, the government had authorized $2.3 billion in spending commitments for GGRA initiatives. Of this amount, almost $1.9 billion was released to cover GGRA-related costs incurred by individual ministries (although actual spending was slightly lower at $1.85 billion, likely due to delays in project implementation). According to the government, no funding was released post-March 31, 2018.

The GGRA had a balance of just over $1 billion.

This left a balance of $553 million in the GGRA for the 2017/2018 fiscal year. When added to the revenues from the May 2018 auction, at the time of publication the GGRA had a balance of just over $1 billion (see figure B.2). This money was to be used only for the purposes set out in the *Climate Act* (i.e., "to reduce, or support the reduction of, greenhouse gas").

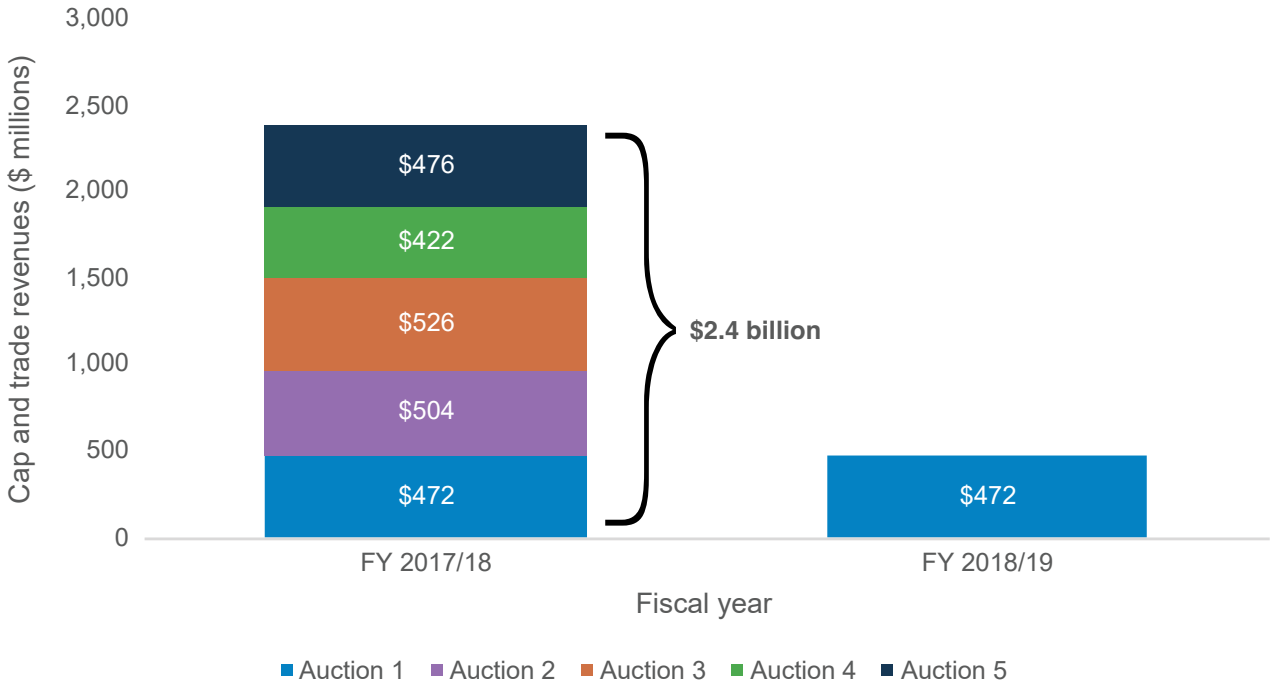


Figure B.1. Since its January 2017 launch, cap and trade raised almost $2.9 billion over six auctions ($2.4 billion in 2017/2018 and $472 million in 2018/2019). By law this must be used for Greenhouse Gas Reduction Account initiatives to reduce, or support the reduction of, GHG emissions.

Source: Ministry of the Environment, Conservation and Parks.

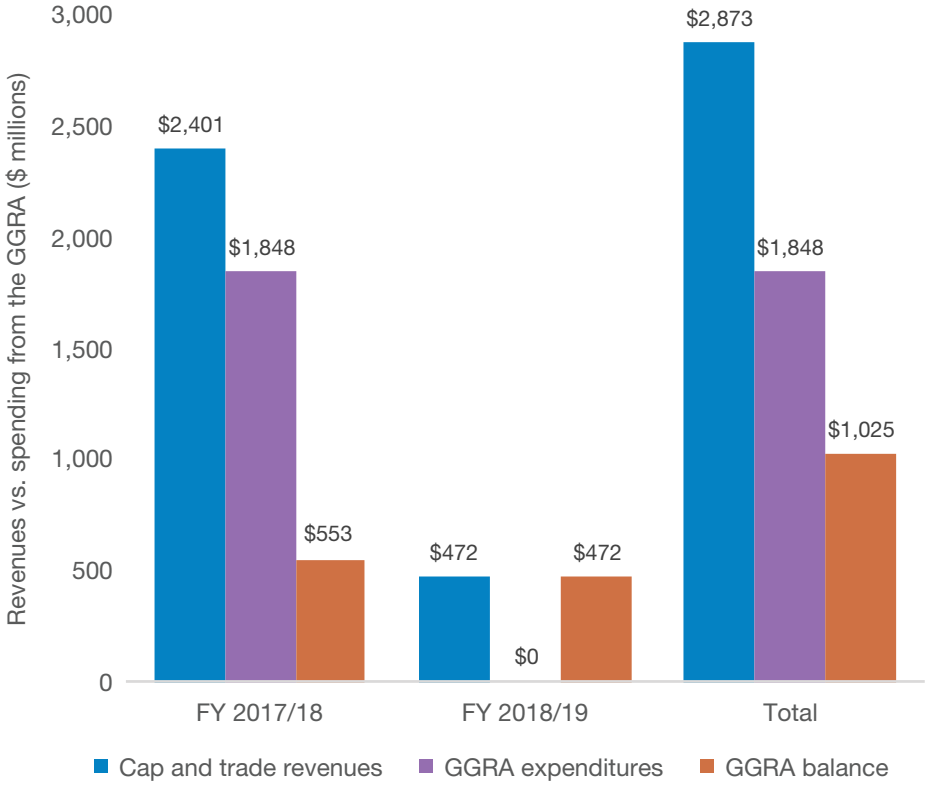


Figure B.2. Of the nearly $2.9 billion raised by cap and trade, more than $1.8 billion was spent on Greenhouse Gas Reduction Account (GGRA) initiatives in 2017/18. No further funds have been released from the GGRA since March 31, 2018. Following the final cap and trade auction in May 2018, a balance of over $1.0 billion remained in the GGRA.

Source: Ministry of the Environment, Conservation and Parks.

In July 2018, the government tabled legislation to repeal the *Climate Act* (Bill 4, the *Cap and Trade Cancellation Act*). The proposed legislation renames the GGRA as the Cap and Trade Wind Down Account, to also be used to cover:

- costs related to the administration of the *Cap and Trade Cancellation Act*
- costs incurred in connection with the repeal and wind down of the *Climate Act*
- costs related to the wind down of initiatives funded under the GGRA, and
- compensation for cap and trade participants.

The total costs of winding down cap and trade and the GGRA are not yet known, but are likely to be less than $1 billion. The government has estimated that compensation for participants who can no longer use allowances will not exceed $5 million, and administration costs for the entire cap and trade program were only $19 million for 2017/2018. Therefore, it is likely that the Cap and Trade Wind Down Account will still contain a significant balance once these other costs are covered. In the opinion of the ECO, this balance can only lawfully be used for reducing greenhouse gas (GHG) emissions.

B1.2 How were cap and trade revenues spent?

The government distributed $1.9 billion from the GGRA to 50 initiatives between November 2015 and July 2018. Many of these initiatives had numerous individual projects, and the total number of funding recipients was more than 500.

85% went to initiatives to reduce GHG emissions or improve energy efficiency in buildings and transportation.

Most of the funding (85%) went to initiatives to reduce GHG emissions or improve energy efficiency in Ontario's buildings and transportation sectors. These are Ontario's two fastest growing sources of GHG emissions. Table B.1 and Figure B.3 below show how this funding was allocated and spent by sector. For a full list of GGRA initiatives, please refer to section B4 at the end of this Appendix.

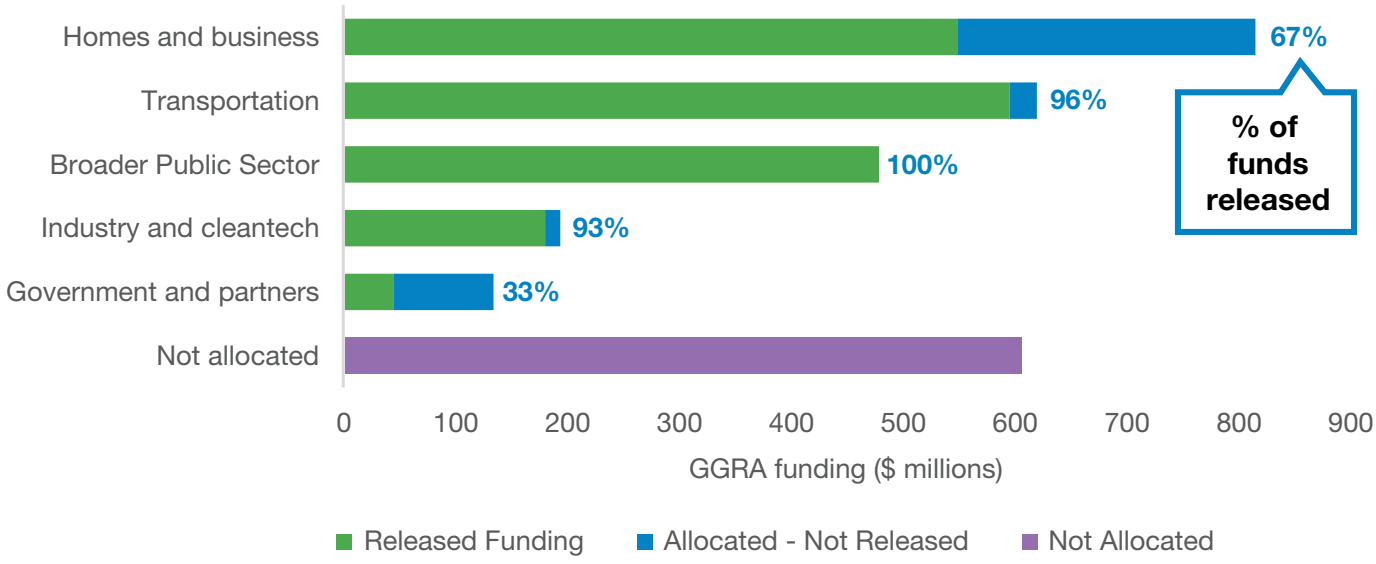


Figure B.3. Greenhouse Gas Reduction Account (GGRA) funding allocations by sector, in millions of dollars.

Source: Ministry of the Environment, Conservation and Parks.

Table B.1. Greenhouse Gas Reduction Account funding allocations by sector.

Note: not all released funds were spent by the end of the 2017/2018 fiscal year.

Sector	Initiatives	Funding allocation	Funding released (% of allocation)	Key initiatives
Homes and businesses	7	$815 million	$548 million (67)	GreenON, energy efficiency retrofits for social housing, homes and businesses
Transportation	18	$619 million	$596 million (96)	GO Transit, electric vehicles and buses, cycling infrastructure
Public sector organizations	4	$478 million	$478 million (100)	Energy retrofits and upgrades for schools, hospitals, colleges and universities
Industry and cleantech	9	$193 million	$179 million (93)	TargetGHG, Low-Carbon Innovation Fund
Government and partnerships	8	$133 million	$44 million (33)	Municipal GHG Challenge Fund
Administration	1	$19 million	$19 million (100)	Cap and trade implementation
Land use	3	$3 million	$3 million (100)	Soil health, 50 Million Trees
Grand total	**50**	**$2,262 million**	**$1,867 million (83)**	

B1.3 Who received funding?

More than 500 Ontario-based public and private sector organizations received GGRA funding, including:

- 120+ municipalities
- 120+ businesses
- 98 hospitals
- 72 school boards (and 600+ schools)
- 50+ social housing providers
- 48 colleges and universities

Many of these organizations had committed to projects and contracts or additional staffing, and now face cuts related to lost or reduced funding commitments from the provincial government.

More than 500 Ontario-based public and private sector organizations received GGRA funding.

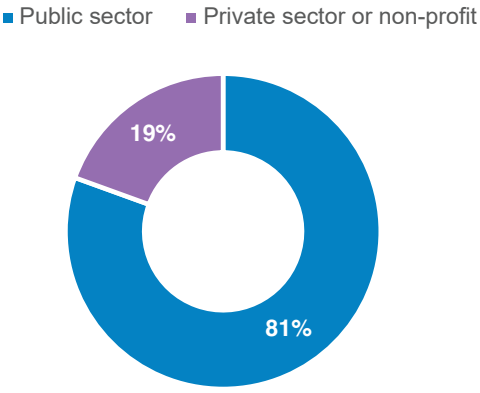


Figure B.4. Most GGRA funding went to public sector bodies in Ontario, such as municipalities, hospitals, schools and social housing providers.

Source: Ontario Ministry of the Environment, Conservation and Parks.

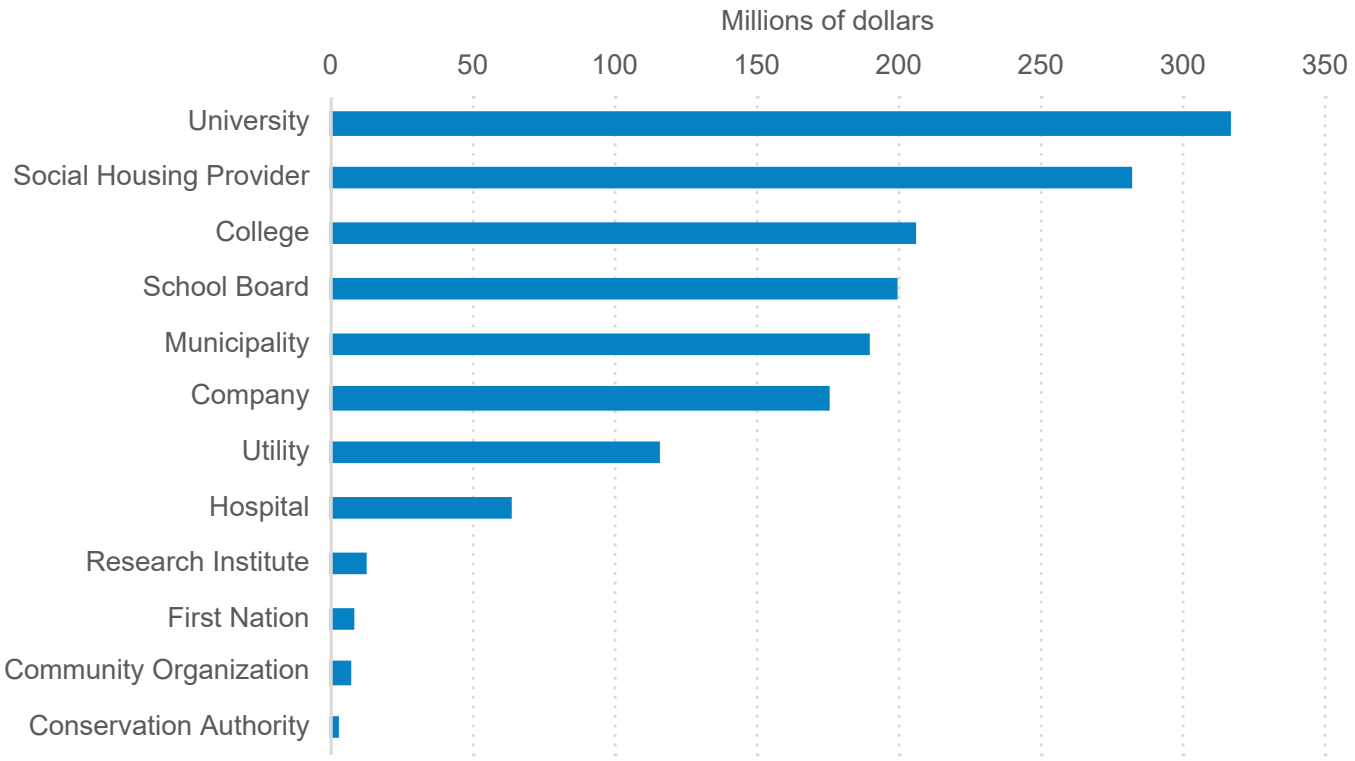


Figure B.5. Greenhouse Gas Reduction Account funding by recipient type, in millions of dollars.

Source: Ontario Ministry of the Environment, Conservation and Parks.

B1.4 Where was funding allocated in Ontario?

Of the $1.5 billion in allocated funding that the ECO could analyze in terms of project location, $713 million (47.2%) went to the Greater Toronto Area, and $265 million (17.5%) went to central Ontario. These two regions account for 70% of Ontario's population (2017) and are experiencing rapid population growth. Figure B.6 shows how GGRA funding was allocated across Ontario.

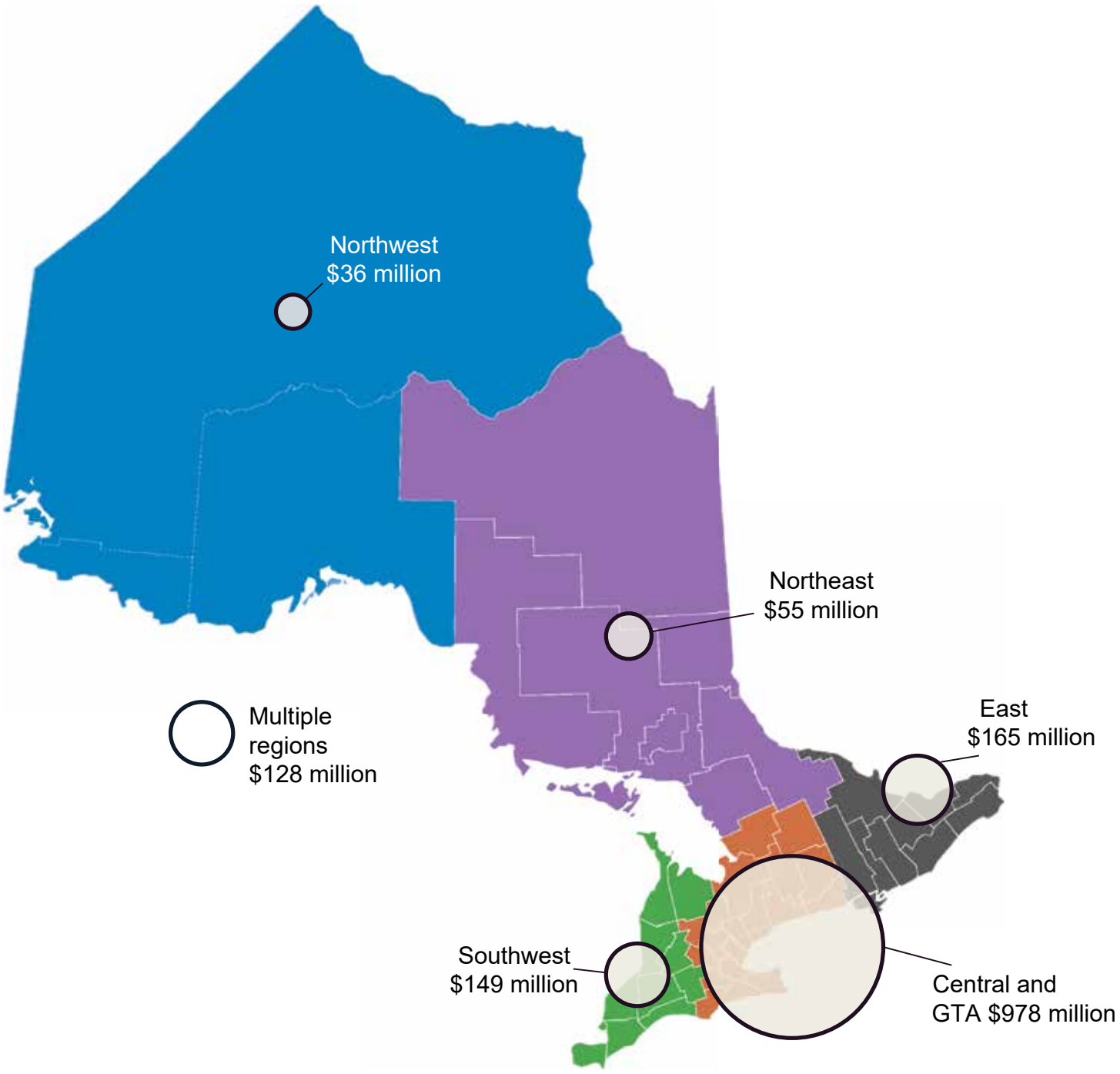


Figure B.6. Map showing how much GGRA funding was allocated to Ontario regions.

Source: Ministry of the Environment, Conservation and Parks.

GGRA projects were taking place in more than 200 lower-tier municipalities and 50 upper or single-tier municipalities.

GGRA projects were taking place in more than 200 municipalities.

Table B.2. Upper- or single-tier municipalities where Greenhouse Gas Reduction Account projects were taking place, prior to the cancellation of cap and trade. Numbers may not add up due to rounding.

Municipality (single or upper tier)	GGRA allocation ($ millions)	Percentage
Toronto	521.5	34.5%
Multiple municipalities	134.8	8.9%
Ottawa	97.2	6.4%
Peel	79.3	5.3%
Middlesex	70.0	4.6%
Hamilton	56.2	3.7%
Essex	46.8	3.1%
Hastings	41.9	2.8%
Niagara	41.7	2.8%
Durham	41.4	2.7%
Waterloo	40.0	2.6%
Wellington	39.2	2.6%
York	38.2	2.5%
Peterborough	29.7	2.0%
Thunder Bay	29.4	1.9%
Halton	23.6	1.6%
Simcoe	19.5	1.3%
Greater Sudbury	16.0	1.1%
Haldimand-Norfolk	15.9	1.1%
32 others	127.3	8.4%
Total	**1,510.5**	**100%**

B2 Results and progress – 2016 to 2018

Delivering climate change results takes time. Ontario has a large, complex economy and a population of more than 14 million. Many sectors (e.g., transportation, building heating, industry) are heavily reliant on fossil fuels, and developing and implementing low-carbon alternatives does not happen overnight. Expertise, experience, labour, equipment and supply chains for low-carbon alternatives all take time to develop. The GGRA was forecast to receive about $1.9 billion/year to transform an $800 billion/year economy. On top of this, some of the most cost-effective actions to reduce GHG emissions (e.g., shutting down coal power plants) have already been taken.

Low-carbon alternatives do not happen overnight.

Given this, the ECO would not expect that the initiatives funded through the brief existence of the GGRA would have delivered significant GHG results. Many individual projects were funded and implemented, some more effectively and justifiably than others, as discussed in our 2017 Annual Greenhouse Gas Progress Report. A large number of projects were only just beginning by June 2018, when cap and trade (and by extension, the GGRA's source of funding) was cancelled.

We discuss some of the implications of the sudden and wholesale cancellation of the 50 GGRA initiatives – and more than 500 individual projects – in section B3. In section B2.1 below, we briefly summarize some of the progress made in key areas. Unfortunately, given (a) the time lag between climate actions and results, and (b) limited government reporting on outcomes, we are unable to provide a full evaluation of the impacts of GGRA expenditures. The final section of this appendix (B4) includes a list and summary of projects funded through the GGRA, including information (where available to the ECO) of progress under each initiative.

B2.1 Progress in key initiatives

Buildings

- Energy efficiency upgrades at:
  - 19,000 social housing units across more than 50 social housing providers
  - 98 hospitals
  - 621 schools across 72 school boards
  - 48 universities and colleges
- Estimated 1 million tonnes of GHG emissions reduced in homes and social housing buildings
- 15,000 home retrofits completed
- 160,000 smart thermostats distributed

Transportation

- Improvements and upgrades to more than 12 GO train stations to support electrification and Regional Express Rail
- 400 public electric vehicle charging stations installed across the province
- 2,400 home charging applications received
- 3,500 electric vehicle incentives distributed and 7,800 additional applications
- 120 municipalities received funding for commuter cycling infrastructure
- 112 bicycle lockers installed at commuter parking lots

Industry and cleantech

- 43 industrial demonstration and research and development projects received funding
- For every $1 invested in industry programs an additional $3.20 was invested in Ontario by businesses
- 65 small and medium manufacturers received funding for energy efficiency upgrades
- 57 small businesses set GHG reduction targets covering 100,000 tonnes

Government and other partners

- 129 municipalities received funding for GHG reduction projects
- $200 million in municipal matching funds for $88 million in provincial investment, under the Municipal GHG Challenge Fund
- Approximately 80 First Nations engaged in energy and adaptation planning

The cancellation of the GGRA will have a range of potential impacts.

B3 Implications of GGRA cancellation

The cancellation of the GGRA will have a range of potential impacts, including:

- fewer – and more costly – GHG reductions
- loss of promised funding for energy efficiency projects, building upgrades, transportation infrastructure, cleantech innovation, and others
- economic and employment impacts
- loss of needed improvements to Ontario's infrastructure and public buildings and facilities
- impacts to businesses, municipalities, hospitals and other public sector institutions that had made major investments (of time, money, and talent) based on committed GGRA funds (as also discussed in section 1.4 of this report)
- loss of matching funds for climate change projects, and
- reduced priority given to climate change in the private sector, municipalities and other sectors.

B3.1 Greenhouse gas reductions

The government estimated the projected GHG reductions directly associated with most GGRA initiatives, other than those that would reduce only emissions indirectly (e.g., cleantech research and development or public engagement). These projected GHG reductions, and the resulting cost per tonne of each initiative, were used in the government's decision-making process when allocating GGRA funds. The government also developed funding scenarios for future years (2018-2021) to assess the impacts on projected GHG emissions of increasing or decreasing funding levels.

Based on our analysis of these estimates, our findings are:

- most GHG reductions were expected to come from homes, buildings and industry (in particular through the GreenON program, which had a relatively low predicted cost per tonne),
- industry and low-carbon fuels were expected to provide the lowest cost emission reductions,
- transit, active transportation and electric vehicles were expected to provide the highest cost emission reductions, and
- cost effectiveness of initiatives was expected to improve with time. Early termination of program funding will dramatically reduce the predicted GHG reductions and increase their per-tonne costs (see "very conservative" scenario in Figure B.7).

Most GHG reductions were expected to come from homes, buildings and industry.

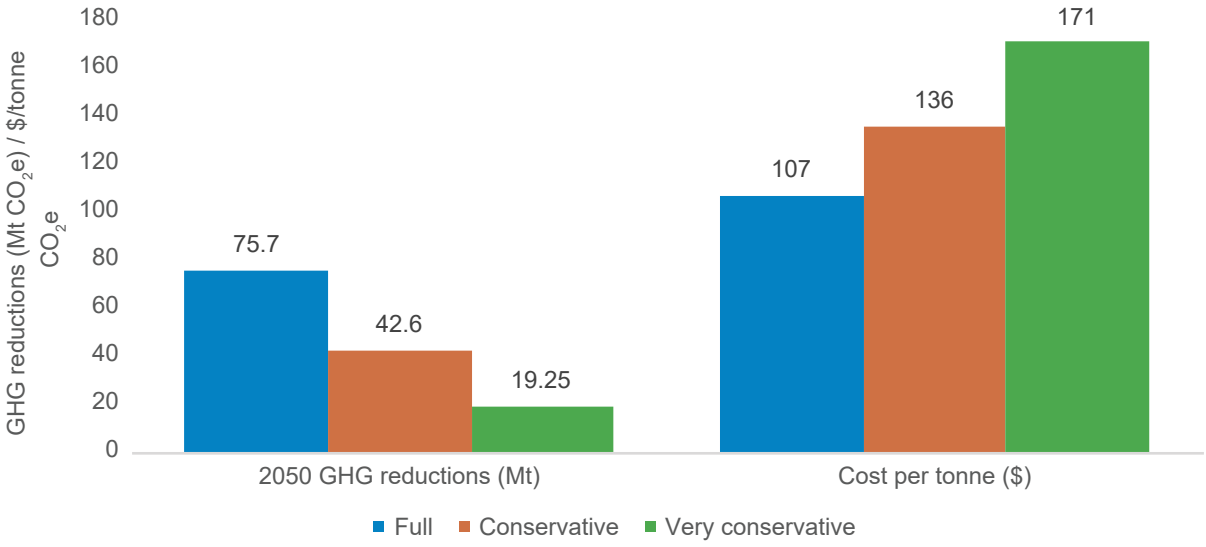


Figure B.7. GHG and cost-per-tonne impacts of a range of GGRA funding scenarios. Full assumes all initiatives receive full funding commitments over four years (2017 to 2021). Conservative assumes full funding for years one and two and 50% funding for years three and four. Very conservative assumes full funding for years one and two and no funding for years three and four.

Source: Ontario Ministry of the Environment and Climate Change, 2018-19 Greenhouse Gas Investment Plan, March 2018.

B3.2 Loss of funding

Nearly $1.9 billion was approved and released by the government for GGRA projects. Another $440 million in funding commitments was carried forward to 2018/2019 and future fiscal years. This includes $262 million for GreenON and $90 million for Municipal GHG Challenge Fund projects.

In June 2018, the government announced it is cancelling cap and trade and any associated programs. This means that all GGRA initiatives have been cancelled, including funding agreements for 2018/2019 and onwards. In addition, the government has requested that some recipients of funding in 2017/2018 submit wind-down cost estimates and return unspent funds.

There were more than 500 recipients of GGRA funding, ranging from municipalities to schools to social housing providers to small businesses.

B3.3 Impacts to key sectors

There were more than 500 recipients of GGRA funding, ranging from municipalities to schools to social housing providers to small businesses, and beyond. It is not yet clear how many of these will be impacted by the GGRA cancellation.

Some initiatives (e.g., Social Housing Apartment Improvement Program and Ontario Municipal Cycling Commuter Program) will allow recipients to spend the full amount granted in 2017/2018, but they will not receive committed funds for future years, some of which had already been earmarked for critical repairs and other projects. For other initiatives (e.g., Municipal GHG Challenge Fund, GreenON Industries), the government has requested recipients to return unspent funds and calculate wind-down costs. These costs could run into the millions of dollars, not including potential litigation costs.

The initiatives funded through the GGRA would have led to tens of thousands of new jobs.

According to the government's own estimates, the initiatives funded through the GGRA would have led to tens of thousands of new jobs in industries like construction, building renovations, and cleantech, while also stimulating hundreds of millions of dollars in GDP and economic benefits. For example, studies have found that every $1 million invested in multi-family housing energy retrofits creates 6-14 jobs and adds $1.3-$3.9 million to the economy.

In addition, energy retrofits can save hospitals, schools and other institutions millions of dollars over their lifetime. These savings can be reinvested into improved patient care and student programs.

B4 Summary of GGRA initiatives, by sector

Social housing buildings

Table B.3. Summary of social housing initiatives funded by the GGRA.

Note: The Green Investment Fund (GIF) was set up prior to cap and trade, and was reimbursed with cap and trade revenues in 2017/2018.

Program	Committed funding	Purpose	Progress	Current status
Social Housing Apartment Improvement Program	$225 million	Energy efficiency retrofits for high-rise social housing buildings with >150 units.	Launched August 2017. Up to $657M committed over 5 years.	Funding for years 2-4 (2018-2020) was cancelled as of July 9, 2018.
Social Housing Apartment Retrofit Program (GIF)	$82 million	Energy efficiency retrofits for high-rise social housing buildings with >150 units.	Ran from February 2016 to April 2018. 78 apartment buildings with almost 18,000 units received retrofits. Est. lifetime GHG savings of 240,000 tonnes.	Housing managers must collect and report on post-retrofit energy data for 3 years.
Social Housing Electricity Efficiency Program (GIF)	$10 million	Energy and electricity retrofits for low-density social housing.	Ran from February 2016 to April 2017. 358 retrofit projects representing 1,246 housing units.	Housing managers must collect and report on post-retrofit energy data for 3 years.
GreenON Social Housing	$25 million	Energy retrofits in small (<100 unit) social housing buildings.	Program was over-subscribed, receiving $210 million in requests from 41 social housing providers.	Program was cancelled in July 2018.
Total funding	**$342 million**			

The province committed $342 million (with the promise of up to $657 million over 4 years) towards repairs and energy efficiency retrofits in social housing across Ontario. More than 19,000 units in large apartment buildings and low-density buildings had received retrofits – such as better insulation and upgraded heating and air conditioning systems – by the start of 2018.

The social housing programs were anticipated to reduce more than 1.5 million tonnes of GHG emissions by 2050, generate jobs and economic savings, and improve comfort for low-income and vulnerable residents. Early results suggested savings of 0.67 tonnes per unit per year (the useful life of retrofits is approximately 20 years), at a cost of $336 per tonne. Extrapolating this to the units receiving retrofits in 2016 and 2017, this suggests the programs will achieve lifetime savings of around 240,000 tonnes. Under the terms of the agreements signed by social housing providers, they are to report on pre- and post-retrofit energy usage for three years.

Homes and businesses

Table B.4. Summary of home and business energy efficiency initiatives funded by the GGRA.

Note: The Green Investment Fund (GIF) was set up prior to cap and trade, and was reimbursed with cap and trade revenues in 2017/2018.

Program	Committed funding	Purpose	Progress	Current status
GreenON (Green Ontario Fund)	$378 million	Improve uptake of energy-efficient technologies in homes and businesses.	Residential rebates launched August 2017. Over 150,000 smart thermostats distributed. Additional programs for industry, small business, First Nations, social housing, and wood and solar power announced in 2018. $100 million in federal funding leveraged.	GreenON and all related programs were cancelled in June 2018. Deadline for rebates extended to October 31, 2018.
Home Energy Audits and Retrofits (GIF)	$115 million	Expand utility-run residential natural gas conservation programs.	Launched October 2016. As of December 2017: ~15,000 homes received retrofits. 10,000 smart thermostats distributed. 760,000 tonnes GHG reduced.	Program ended March 31, 2018.
Total funding	**$493 million**			

The government committed almost $500 million towards reducing energy use and GHGs from homes and businesses through these two programs. The Home Energy Audits and Retrofits program was launched in February 2016 as part of the Green Investment Fund. It expanded the demand side management programs, run by the natural gas utilities Enbridge and Union Gas, to reach an additional 37,000 homes with energy audits and retrofits (e.g., new high-efficiency furnaces, water heaters, insulation).

The Green Ontario Fund (GreenON) was created as an independent agency to offer a one-window approach to energy saving technologies and retrofits. It launched in August 2017 and initially focused on offering energy savings advice and distributing smart thermostats (150,000 in the first year). In December 2017 it launched two new programs:

- the $200-million GreenON Industries program (which supported large-scale demonstration projects to reduce facility and manufacturing GHG emissions), and
- the GreenON Rebates program, which offered up to $20,000 in incentives for residential energy retrofits like high performance windows, insulation and heat pumps.

Subsequent programs were launched in 2018, targeting energy retrofits and innovation projects in social housing (discussed above), agriculture and food manufacturing, and small- and medium-sized businesses. GreenON also launched:

- four Modern Wood Heating Pilots in northern and Indigenous communities without natural gas access,

to support replacement of inefficient wood stoves and fossil fuel heating systems with high-efficiency wood heating systems,

- a $90-million solar rebate initiative to encourage residential and business solar panel installation (planned for summer 2018), and
- the $300-million GreenON Challenge program to solicit GHG reduction ideas from businesses.

The agency was also looking into opportunities to leverage private investment, along the lines of Green Bank models in jurisdictions such as Connecticut, New York State and the United Kingdom.

Transportation

Table B.5. Summary of low-carbon transportation initiatives funded by the GGRA.

Program	Committed funding	Purpose	Progress	Current status
GO Regional Express Rail	$324 million	Support GO transit electrification and upgrades.	Improvements underway at 12 GO stations. Planning work for 30 stations in procurement. Environmental assessments underway for rail corridor expansion.	N/A
Electric vehicle programs (bundled)	$179 million	Increase adoption of electric vehicles (EVs) in Ontario.	7,500 EVs sold in 2017 (3% of new car sales and +120% over 2016). 400 public charging stations installed. 2,400 applications for home charging stations.	All EV and charging incentive programs were cancelled on July 11, 2018.
Cycling infrastructure	$104 million	Build bicycle lanes and parking to encourage cycling.	120 municipalities received funding.	Cancelled July 4, 2018. No impact on municipal funding for 2017/2018.
Various	$11.5 million	Includes hydrogen trains pilot, high-speed rail, electric municipal and school buses, Green Ferries, Green Commercial Vehicle Program.	Programs were in early stages.	Cancelled July 25, 2018.
Total funding	**$618.5 million**			

There is a strong case for promoting EVs as alternatives to conventional gasoline vehicles due to Ontario's 96% clean electricity grid.

Electric vehicles

Electric vehicles (EVs) are a key part of reducing Ontario's transportation emissions (see section 3.1). Much of the province is built at low densities with limited opportunity for public transit or active transportation. This means many Ontarians have little choice but to drive for most of their trips. There is a strong case for promoting EVs as alternatives to conventional gasoline vehicles due to Ontario's 96% clean electricity grid. Even when factoring in the higher manufacturing impacts of EVs compared with gasoline vehicles, the lifecycle GHG emissions are about 99% lower (over a 15-year period).

The government released almost $180 million for various EV programs. These included the Electric Vehicle Incentive Program (later expanded to include hydrogen vehicles), which provided incentives of up to $14,000 to purchase an EV; and the Electric Vehicle Charging Program, which provided incentives for workplaces, shops, conservation areas and other destinations to install charging stations. Both programs were criticized for handing out rebates to wealthy car owners and for delays in installation which led to frustration for EV owners.

The results from the EV initiatives were mixed, but overall Ontario was seeing a measurable shift in the EV market.

The results from the EV initiatives were mixed, but overall Ontario was seeing a measurable shift in the EV market. According to FleetCarma, an industry group that specializes in data analysis, Ontario overtook Quebec in EV sales in 2017, with 7,500 vehicles sold (an increase of 120% from 2016). In the first two quarters of 2018 this strong growth continued, with another 9,499 EVs sold (a 189% increase over the same period in 2017). This mirrors the growth in incentives and applications through the Electric Vehicle Incentive Program (3,500 in 2016/2017, 7,800 in 2017/2018).

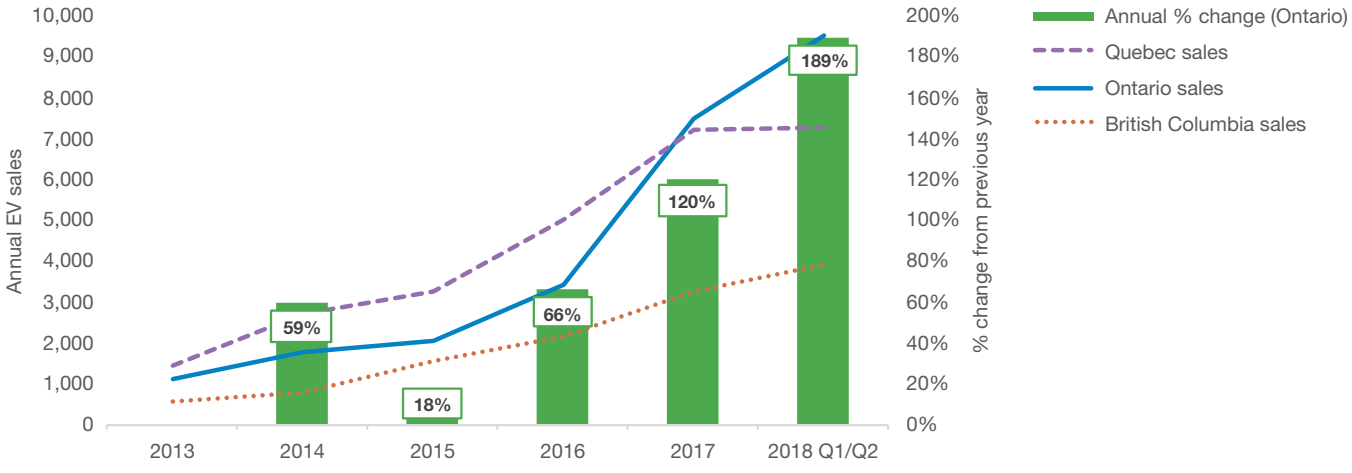


Figure B.8. Annual sales of electric vehicles in Ontario, Quebec, British Columbia from 2013 to the first two quarters of 2018. The bars show the year-on-year percentage change in Ontario sales.

Source: FleetCarma.

In the 2016 Ontario Climate Change Action Plan, the government set a target for EVs to be 5% of passenger vehicle sales in 2020. Data suggests that Ontario was on its way to meeting this target: 2.6% of all motor vehicles sold in the second quarter of 2018 were EVs. If similar rates of growth were to continue, the 5% target will likely be met by 2020.

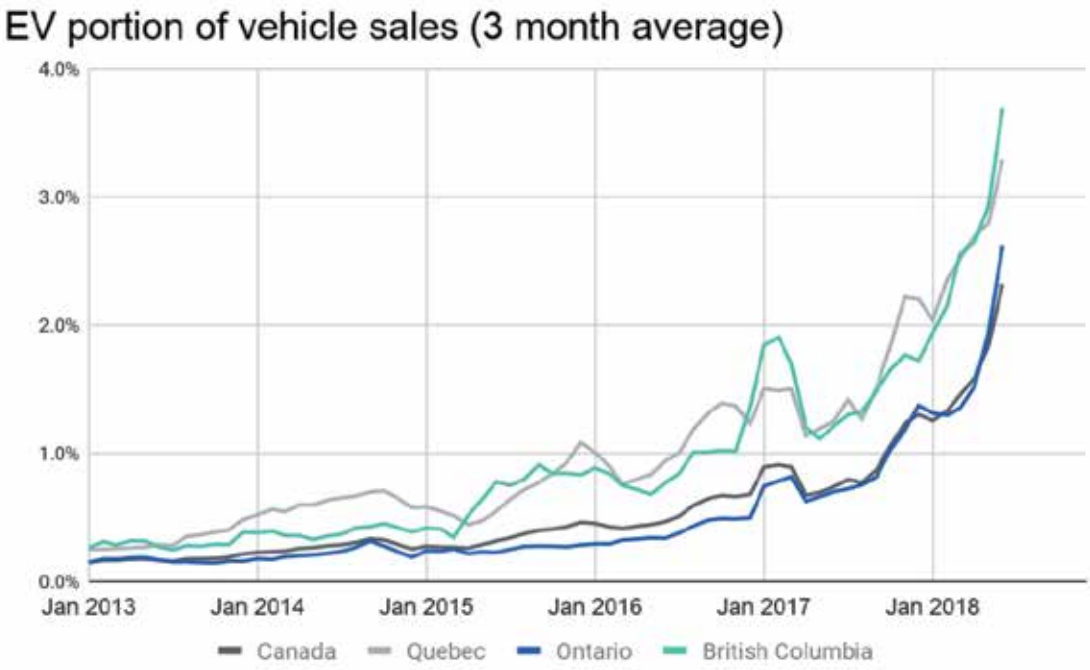


Figure B.9. Electric vehicles as a percentage of all vehicles sold in Canada and three provinces (including Ontario).

Source: FleetCarma.

The government had also set targets to install public EV charging stations at key locations to address the range anxiety that many EV drivers feel on longer journeys. The initial target was 475 chargers installed by April 2017. When it became clear this target would not be reached, the government delayed it to April 2018. As of May 2018, about 70% of these were up and running, with an additional 100 charging stations at GO stations, Ontario Parks and other government facilities. The program was beset with challenges and criticism about the location and reliability of chargers, and the awarding of a large contract to a company with relatively little prior experience installing charging networks.

Transit

Almost $600 million of cap and trade revenues were for low-carbon transportation projects. About half of this went towards the electrification of GO Transit, as part of the Regional Express Rail plan to provide all day, two-way 15-minute train service in the Greater Toronto and Hamilton Area. Over the next 10 years the government and Metrolinx (the provincial agency that manages GO Transit) aims to grow weekly train trips from 1,500 to 6,000, reducing GHG emissions directly (by shifting from diesel to electric trains) and indirectly (through land use and travel mode changes). Full electrification is expected to be completed by 2025. Improvements to GO Transit were complemented by GGRA investments in electric vehicle charging infrastructure and cycling infrastructure to address the first mile-last mile challenge around GO stations.

As of September 2018, the government has not indicated whether it will make changes to the existing GO RER/electrification plans. However, it has refused to commit to reducing the cost of GO Transit fares for trips within Toronto – a commitment that was funded by cap and trade revenues – putting other major transit projects (i.e., Smart Track) in jeopardy.

Over $100 million was allocated to support cycling infrastructure in Ontario municipalities.

Cycling infrastructure

Through the Ontario Municipal Commuter Cycling Program, over $100 million was allocated to support cycling infrastructure in Ontario municipalities, with the goal of increasing the number of people who commute by bicycle to 1.9% in 2030 (up from 1.2% in 2016). The government estimated that its investments in cycling would have a fairly minor impact on GHG reductions (although these initiatives will likely have significant public health and air quality co-benefits).

One hundred and twenty municipalities applied for and received funding through the program in 2017/2018. The bulk of funding went to large municipalities where cycling is already well established as a mode of commuting: Toronto ($25.6 million), Ottawa ($9.7 million), Peel Region/Mississauga/Brampton ($8.3 million), York Region/Markham/Vaughan/Richmond Hill/Newmarket ($6.3 million), Hamilton ($3.7 million), London ($3.3 million) and others. The program was cancelled on July 4, 2018, with no future funding and the requirement that all projects funded must be completed by 2020.

Public sector institutions

Table B.6. Summary of public sector building initiatives funded by the GGRA.

Program	Committed funding	Purpose	Progress	Current status
Hospital Energy Efficiency Program	$64 million	Hospital energy retrofits and waste anaesthetic gas collection/recycling.	Launched November 2017. 180 projects at 98 hospitals received funding in 2017/2018. Waste anaesthetic gas projects were scheduled to launch in summer 2018.	Program has been cancelled.
School Retrofits (Greenhouse Gas Reduction Fund)	$200 million	Improve energy efficiency in school buildings.	Program launched in April 2017. Funding was distributed to 621 schools and 72 school boards in 2017/2018 (including $50 million for Toronto District School Board).	$100 million for 2018/19 was cancelled in July 2018.
University and College Retrofits	$214.4 million	Grants and low-interest loans to improve energy efficiency in colleges and universities.	Program launched June 2017. Funding was disbursed to 20 universities and 24 colleges in 2017/2018.	$300 million Loan Fund was due to be launched in summer 2018. Program has now been cancelled.
Total funding	**$478.4 million**			

Hospitals

Through its Hospital Energy Efficiency Program, the government committed $64 million in 2017/2018 towards 180 energy efficiency retrofits at 98 hospitals across the province. The majority (117 projects and 80% of funds) were for heating, ventilation and air conditioning projects; $5.6 million was also spent on projects to improve lighting efficiency. The ECO was critical of using GGRA funding for lighting and other electricity efficiency retrofits in the past, due to the low-GHG intensity of Ontario's electricity grid. We received no justification for why the Ministry of Health and Long-Term Care used GGRA funds to support lighting projects.

The ECO was critical of using GGRA funding for lighting and other electricity efficiency retrofits, due to the low-GHG intensity of Ontario's electricity grid.

By the government's own estimates, if fully funded, the Hospital Energy Efficiency Program would have reduced several million tonnes of GHGs by 2050 and saved hospitals up to $68 million in annual energy costs. Three-quarters of the projected GHG savings were expected to come from recycling waste anaesthetic gases, which are used in hospital operating rooms, and have a much larger warming impact than CO_2 (from 130 to 2,540 times as potent). As these waste anaesthetic gas recycling projects were delayed until summer 2018, it is unlikely that they will go ahead. As well as limiting the potential GHG reductions, this may have knock-on impacts to Ontario-based companies that specialize in waste anaesthetic gas collection and recycling; a growing industry with export potential of $2 billion annually.

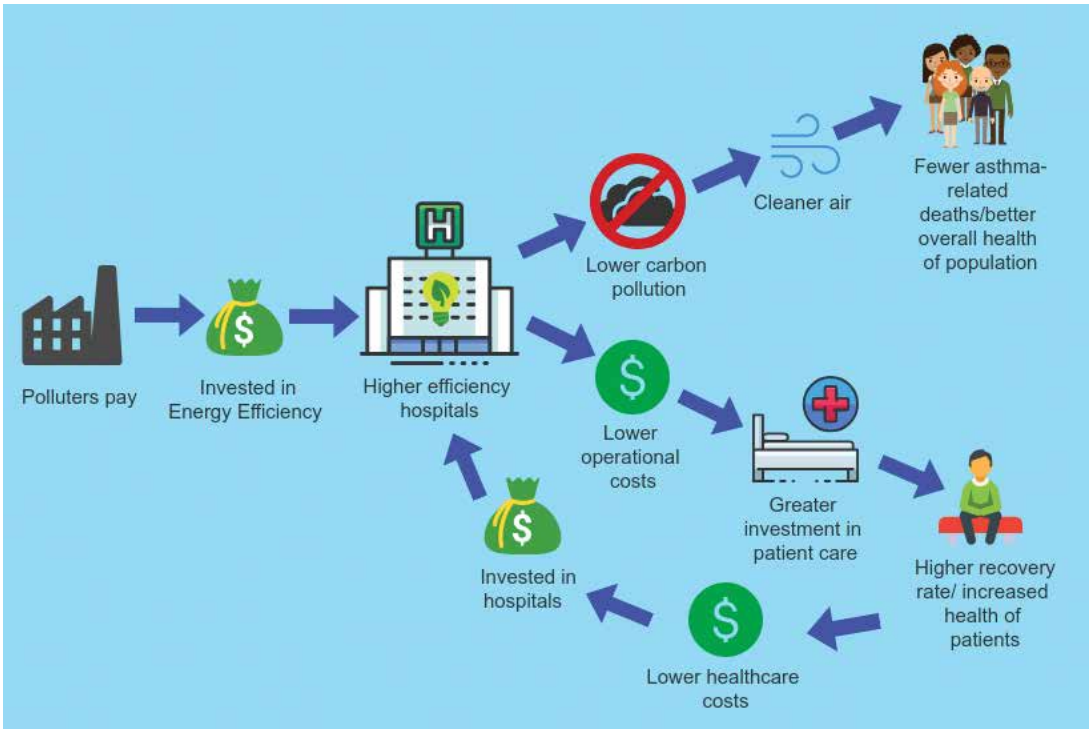


Figure B.10. Infographic showing how hospital energy efficiency retrofits result in health and financial co-benefits.

Schools, colleges and universities

The government committed more than $700 million in grants and interest-free loans to support energy retrofits in schools, colleges and universities across Ontario. As of March 31, 2018, 621 schools and 44 colleges and universities had received funding for heating, ventilation and air conditioning, insulation and other upgrades to improve student comfort and reduce energy costs. The province estimates that 280,000 elementary and high school students will benefit from the school retrofits.

The government committed more than $700 million in grants and interest-free loans to support energy retrofits in schools, colleges and universities.

It is unclear whether the remaining $300 million promised for interest-free loans for colleges and universities will still flow.

The government spent more than $400 million in 2017/2018 to support these projects. It is unclear whether the remaining $300 million promised for interest-free loans for colleges and universities will still flow (some of the biggest promised loans included $37 million to the University of Toronto, $21.7 million to York University, $21.6 million to the University of Western Ontario, and $18.5 million to Queens University).

Industry and cleantech

Table B.7. Summary of industry and cleantech initiatives funded by the GGRA.

Note: The Green Investment Fund (GIF) was set up prior to cap and trade, and was reimbursed with cap and trade revenues in 2017/2018.

Program	Committed funding	Purpose	Progress	Current status
GreenON Industries	$200 million	Support for industrial GHG reduction projects.	Launched December 2017.	All GreenON programs have been cancelled.
TargetGHG (GIF)	$85.7 million	Support industrial demonstration projects and research and development.	Launched November 2016. 11 demonstration projects approved. $3.20 leveraged from industry for every $1 invested into program. 8 additional research and development projects were approved.	Approved projects will continue but several projects are uncertain.
Low-Carbon Innovation Fund	$29 million	Cleantech demonstration and innovation across multiple sectors.	Launched August 2017 with two funding streams (technology validation and demonstration). 23 projects received funding. Up to $46 million leveraged from industry.	Cancelled.
SMART Green (GIF)	$25 million	Improve energy efficiency for small- and medium-sized manufacturers.	Launched February 2016. At the start of 2018, 37 projects had received funding with another 42 being reviewed. Leveraged 50% matched funding.	All funding was committed as of July 3, 2018.

Low Carbon Building Skills	$24 million	Improve capacity of colleges and unions to train workers in low-carbon building skills.	Launched August 2017.	$9.6 million was spent by March 31, 2018.
Cleantech Accelerators	$10.6 million	Developing new GHG-reducing technologies.	Launched February 2018.	Cancelled.
GreenFIT - Public Sector Demonstration Project	$10 million	Boost government procurement of low-carbon goods and services.	Launched February 2018.	Cancelled.
Global Market Acceleration Fund	$8.1 million	Grants for Ontario cleantech companies.	Launched February 2018. Funding provided up to 50% of project costs.	Cancelled.
Sustainability CoLab (GIF)	$1 million	Build networks of small businesses with GHG targets and programs.	Launched November 2016. Network includes 267 businesses, 57 of which have set GHG reduction targets covering 59,000 tonnes.	Funding was spent in 2016/2017.
Total funding	**$393.4 million**			

TargetGHG provided $62.5 million for 29 projects, leveraging an additional $198 million from industry and funding partners.

The government funded a wide range of programs to support businesses and industry to reduce their emissions and encourage cleantech research and development in Ontario.

TargetGHG was an $86 million program administered by the Ontario Centres of Excellence to support large industrial GHG reduction projects and increase the use and adoption of cleantech in industry. Grants were awarded for projects in three streams: (1) industrial demonstration; (2) technology development; (3) prizes for ideas to store and re-use carbon dioxide. As of April 2018, TargetGHG provided $62.5 million for 29 projects, leveraging an additional $198 million from industry and funding partners. Funded projects included:

- using landfill gas from the Walker Environmental disposal facility in Niagara Falls to power General Motors' plant in St. Catharines, reducing GHG emissions by 5,500 tonnes per year (77%) and significantly cutting plant operating and energy costs,
- Stelco steel mill in Hamilton substituting recycled bio-carbon for coal in its coke oven, to reduce 64,000 tonnes of GHGs, divert waste from landfill, and improve competitiveness,
- Goldcorp, a mining company, developed Ontario's first all-electric mine in Chapleau, avoiding more than 6,000 tonnes of GHG emissions annually from diesel, and improving air quality for miners, and
- research and development of new low-carbon power generation technologies.

The full list of announced projects is below (note: some additional projects had not been announced at the time of publication).

Table B.8. TargetGHG industrial innovation and cleantech projects funded by the GGRA.

Stream	Project	Location	GGRA funding	Additional funds leveraged
Industrial Demonstration	Mine of the Future: Canada's First Battery Powered Electric Mine	Chapleau	$51.5 million	$144 million
	GM and IGRS Renewable Energy Project	St. Catharines		
	OCWA/Stratford Net Zero Initiative	Stratford		
	Commercial Algae Carbon Capture	Nanticoke		
	Bowmanville Low Carbon Fuels Project	Bowmanville		
	Heat Recovery and Steam Conservation Project	Thunder Bay		
	GHG Reduction in Concrete Project	Brampton		
	Low Carbon Fuels Project	Kingston		
Technology Development	3E Nano	Toronto	$8 million	$51.7 million
	Integrated Community Energy and Harvesting Systems	Hamilton		
	Advanced Electrified Vehicle Motor Control Technologies	Hamilton		
	Infra-Clean	Toronto		
	Battery-Enabled EV Fast-Charging Station	Toronto		
	Integral Molten Salt Reactor	Oakville		
	QD Solar quantum dots	Toronto		
	SulfaChar	Mississauga		
Prizes/ Challenge	Various		$2 million	$2 million

The Low-Carbon Innovation Fund was a $29-million fund for commercializing or prototyping emerging, innovative technologies (e.g., alternative energy, biofuels, transportation or carbon capture and usage). It was launched in August 2017 and committed $28.8 million to 23 initiatives. Projects supported Ontario-based companies such as Ranovus Inc. to develop new power efficiency data centres, or Mississauga-based Springpower International to develop improved lithium-ion batteries. The full list of projects is below.

Table B.9. Projects supported by Low-Carbon Innovation Fund.

Project Name	Company/ Institution Name	Location	Funding Amount
Power Efficient Data Centers	Ranovus Inc.	Ottawa	$4,000,000
Jewelbox Development	Morgan Solar Inc.	Toronto	$3,000,000
High Density Charging	eCAMION Inc.	Toronto	$2,000,000
High Rate Two-Stage Anaerobic Digestion	Greenfield Global Inc.	Chatham	$2,000,000
Lipid-to-Hydrocarbon Demonstration Project	FORGE Sombra Corporation	St. Clair	$2,000,000
Backcontact Solar PV Modules	Silfab Solar Inc.	Mississauga	$2,000,000
Accelerating Customer Sited Energy Storage	Peak Power Inc.	Toronto	$1,904,500
PowerCone Wind Turbine Technology	Biome Renewables	Southgate	$1,809,801
FuelCHAR	wwCHAR Technologies	London	$1,062,385
Electric Converter Dolly	Electrans Technologies Ltd.	Waterloo	$1,000,000
G2F: Greenhouse Gases to Fuel	University of Toronto	Toronto	$990,495
Perovskite Photovoltaics	University of Waterloo	Waterloo	$900,000
GBatteries	GBatteries Energy Canada Inc.	Ottawa	$900,000
Low Carbon Wastewater Treatment	Trojan Technologies	London	$875,000
Lithium-ion Battery Materials	Springpower International Inc.	Mississauga	$753,984
Seed-Borne Agricultural Crop Technology for GHG Reduction	University of Ottawa	Ottawa	$750,000
Converting Organic Waste to Energy in an Urban Environment	CCI BioEnergy Inc.	Toronto	$700,000
Borealis Wind - De-icing System	Borealis Wind	Kitchener	$500,000
Thermal Cooling with Energy Storage	Thermalfrost Intl. Inc.	Ottawa	$430,000
Phycus Biotechnologies Inc.	Phycus Biotechnologies Inc.	Toronto	$375,000
Smart Electric Vehicle Charging Management	SWTCH E-car Inc.	Toronto	$350,000
Smart Fuel Switching Furnace	iGen Technologies	Richmond Hill	$285,000
Innovative Carbon-Sequestering Fertilizers	University of Guelph	Guelph	$255,369
Grand Total			**$28,841,534**

SMART Green was a $25-million Green Investment Fund initiative, administered by Canadian Manufacturers and Exporters (CME). The program provided support for small and medium manufacturers who were not part of Ontario's cap and trade program (i.e., with annual emissions less than 25,000 tonnes CO_2e), to reduce their GHG emissions and improve energy efficiency and productivity. As of March 31, 2018, the program had committed $19.8 million in GGRA funding to 66 capital projects ($6.5 million had been disbursed). CME estimates that its investment will leverage a combined investment of $39.6 million in Ontario's economy.

Green Economy Canada (formerly Sustainability CoLab) is a non-profit that works with community organizations or hubs and a network of 267 businesses across Ontario to reduce GHG emissions and improve sustainability. It received $1 million from the GIF in 2016 and used it to incentivize more than 40,000 tonnes of GHG reductions in its network. In early 2018 the government announced additional funding of $2.55 million to expand from 7 to 11 hubs, although this commitment is now unclear.

Government and Indigenous partnerships

Table B.10. Summary of government and Indigenous initiatives funded by the GGRA.

Program	Committed funding	Purpose	Progress	Current status
Municipal GHG Challenge Fund	$100 million	Support local GHG reduction projects.	Launched in August 2017. 29 projects received funding (15 municipalities). As of March 31, 2018 the government had released just $10 million (10%) of the committed funding.	The fund and its projects were cancelled on July 10, 2018. Municipalities are asked to provide an estimate of wind-down costs and return unspent funds to the provincial government.
The Atmospheric Fund	$17 million	Reduce air pollution and GHG emissions in the Greater Toronto and Hamilton Area.	Announced October 2016 as an endowment to TAF and expansion of geographic scope. Investment returns to date (~$1 million) used to support innovative GHG reduction projects.	N/A
Infrastructure 2030 Target	$3.9 million	Improve energy conservation by 50% across government facilities.	Ten energy efficiency projects had been started.	Cancelled.
Indigenous Partnerships	$3.8 million	Develop shared climate change policies with First Nations.	Government had established venues for ongoing discussion and capacity building.	Cancelled.
Partners in Climate Action	$3.2 million	Supporting community organizations and private sector GHG reductions.	Funded 10 projects. Research on helping low-income households adapt to climate change. Support for EcoSchools and universities.	Cancelled.

Ontario Climate Change Impacts and Adaptation Resources	$3 million	Build First Nations climate mitigation and adaptation capacity.	Launched March 2016. Agreements signed with groups representing 72 First Nations and communities for a Climate Change Impact Study for the North. Another eight First Nations are preparing adaptation plans.	Cancelled.
First Nation micro-grids	$2 million	Micro-grid solar and energy storage project in Gull Bay First Nation.	Scaled down from two projects to one. Project still under development, expected to be complete in late 2018.	Cancelled.
Climate Change Tools	$0.4 million	Provide general public with information and tools to reduce carbon footprints.	Carbon calculator was due to launch in early 2018. Program had also supported mapping and public engagement activities.	Cancelled.
Total funding	**$133.3 million**			

The provincial government committed $100 million for municipal projects to address climate change. There was huge interest from municipalities, with a ten to one ratio of applications to funded projects in the first round of funding. For 2017/2018, 29 projects were funded across 15 municipalities with $88 million from the GGRA – this leveraged more than $200 million in municipal funding. The projects included transit, district energy, organics and waste, bike share, street improvements, and a range of others that had significant potential to reduce GHG emissions and create local jobs. Municipalities signed transfer payment agreements in March 2018 and funding began to flow soon thereafter – although as of March 31, 2018 just $9.5 million (<10% of the total commitment) had been disbursed to recipients. In July 2018 the provincial government cancelled all municipal projects.

The projects had significant potential to reduce GHG emissions and create local jobs.

Table B.11. Municipal GHG Challenge Fund recipients, showing provincial and municipal funding contributions.

Municipality	Projects	GGRA funding ($ million)	Municipal contribution ($ million)
City of Toronto	10	51.8	94
Region of Peel	1	10	81.5
City of Peterborough	1	7.5	7.5
City of Ottawa	5	5	5.5
Dysart et al	1	2.8	3
Township of Chatsworth	1	2.6	2.6
Town of Blue Mountains	1	2.3	0.3
City of Thunder Bay	1	1.8	1.8
City of Kingston	1	1.75	1.75
City of London	2	1.5	1.6
City of Guelph	1	0.3	0.3
Township of Hornepayne	1	0.2	0.02
Town of Caledon	1	0.2	0.2
Township of Pickle Lake	1	0.07	0.05
Township of Selwyn	1	0.05	0.05
Grand Total	**29**	**88**	**200**

Appendix C: Adaptation efforts in Ontario

The provincial government has taken a number of steps over the last decade to help Ontario adapt to climate change, including creating policies directed specifically at driving adaptation, as well as incorporating adaptation considerations into other initiatives.

Ontario Expert Panel on Climate Change Adaptation (2009)

In December 2007, the Minister of the Environment appointed the Ontario Expert Panel on Climate Change Adaptation, "to help the Ontario government, municipalities and Ontarians prepare and plan for the impact of climate change in areas such as public health, environment, infrastructure and economy."

The Expert Panel's November 2009 report, Adapting to Climate Change in Ontario, noted the "clear need" for a comprehensive strategy to reduce the present and future impacts of climate change. The panel made 57 recommendations, including calling for the launch of a province-wide climate change adaptation action plan.

The panel warned that "[p]iecemeal, uncoordinated actions will be insufficient and costly. A carefully considered, evidence-based strategy with goals, timelines and clear responsibilities is required."

Climate Ready: Ontario's Adaptation Strategy and Action Plan 2011-2014

The Ontario government released its first climate change adaptation plan in April 2011. Climate Ready: Ontario's Adaptation Strategy and Action Plan, 2011-2014 ("Climate Ready") sets out 37 actions to help prepare Ontario for the impacts of a changing climate and take advantage of climate-related opportunities. In particular, the plan calls for the mainstreaming of adaptation: requiring ministries across government to include adaptation as a key consideration when updating existing policies and programs or developing new ones.

The ECO was encouraged that Ontario had started to develop and implement a formal adaptation strategy. However, the government failed to develop a strategic plan to achieve priority adaptation objectives across the province, instead providing what amounted to an inventory of existing government actions and investments. The plan also lacked quantitative or qualitative targets, or specific timelines for delivery.

Climate Ready was to be fully implemented by 2014, but in 2016 the Auditor General of Ontario reported that only about 30% of the actions were fully completed, and 40% of actions had seen little or no progress. Since then, ministries have made some further progress, but as of spring 2018 many Climate Ready actions still remained incomplete.

Ontario's Climate Change Strategy (2015) and Action Plan (2016-2020)

Ontario's Climate Change Strategy and Climate Change Action Plan, released in 2015 and 2016 respectively, focused primarily on greenhouse gas reductions and transitioning Ontario to a low-carbon economy, but acknowledged the importance of adaptation. The strategy included a brief section devoted to adaptation, which envisioned a province that is "better prepared for the impacts of climate change" by 2030. In summer 2018, the new provincial government committed to developing a new plan to address climate change in fall 2018.

Legislation

Climate change adaptation has been referenced in a small number of provincial laws, including the: *Far North Act, 2010; Municipal Act, 2001; Planning Act; Lake Simcoe Protection Act, 2008;* and *Conservation Authorities Act.* The Infrastructure for Jobs and Prosperity Act, 2015 requires the government and every broader public sector entity to consider the principle that "infrastructure should be designed to be resilient to the effects of climate change."

Ministry policies and programs

Several Ontario ministries have created their own adaptation plans, incorporated climate change adaptation considerations into more focused programs and initiatives, or have undertaken research or assessments of specific climate-related impacts and adaptation needs.

For example, in 2017, the Ministry of Natural Resources and Forestry (MNRF) released Naturally Resilient – MNRF's Natural Resource Climate Adaptation Strategy (2017-2021), a strategic framework to help the ministry address key areas of climate change vulnerability and support climate change adaptation efforts. The same year, the Ministry of the Environment and Climate Change (now called the Ministry of the Environment, Conservation and Parks) released a climate change adaptation strategy specific to Lake Simcoe, and the Ministry of Energy released its 2017 Long-Term Energy Plan, which commits to better preparing Ontario's energy systems for extreme weather events. The Ministry of Municipal Affairs' Growth Plan for the Greater Golden Horseshoe, 2017 requires municipalities to develop policies and identify actions in their official plans that will address adaptation goals, such as stormwater management and protecting natural heritage and water resources.

In spring 2018, the Ontario Ministry of Agriculture, Food and Rural Affairs finalized its Agricultural Soil Health and Conservation Strategy, which identifies climate-related risks to agricultural soil health and aims to improve resiliency of farmlands.

In recent years, the Ministry of Transportation has, among other things, undertaken work to assess the resilience of Ontario's highway system's drainage infrastructure to climate change. The ministry has also developed a rainfall intensity forecasting tool to be used for updates to or planning of new highways and roads.

Work with the federal government, provinces and other partners

Ontario has collaborated with other provinces and the federal government to address climate change. In December 2016, Canada's federal, provincial and territorial leaders adopted the Pan-Canadian Framework on Clean Growth and Climate Change. Although focused primarily on reducing greenhouse gas emissions, one of the four pillars of the Pan-Canadian Framework focuses on adaptation and climate resilience. The framework identifies actions to support adaptation across Canada.

The former Ministry of the Environment and Climate Change also participated, with other ministries, provinces and organizations, in Natural Resources Canada's Adaptation Platform. The Adaptation Platform is a national forum that collaborates on climate change adaptation priorities and aims to equip decision makers with the information and tools needed to adapt.

Ontario has also worked with other partners to conduct regional and watershed-level climate change vulnerability assessments across the province. For example, the MNRF worked with local partners to complete a vulnerability assessment of the northeastern Ontario Clay Belt, with a special emphasis on forestry. Similarly, the ministry is working with the Mississippi River and Rideau Valley conservation authorities to undertake vulnerability assessments in those areas. The province also completed a climate vulnerability assessment for the Lake Simcoe watershed.

Appendix D: Precipitation trends in Ontario

Abstract

Floods are now the most-costly type of natural disaster in Canada.

In recent years, the frequency and severity of floods have increased across Canada. These flood events are often associated with spring snowmelt, rain-on-snow, long-duration heavy precipitation events or short-duration intense storms. Climate change makes these events more likely; land use change associated with urbanization worsens the consequences.

In Ontario, and across Canada, these flood events have caused substantial damage, including financial losses, damage to infrastructure, reduced crop productivity, and even loss of human life. Notable and costly extreme flood events have occurred in recent years in the cities of Brampton, Burlington, Etobicoke, Hamilton, Mississauga, Muskoka, North Bay, Ottawa Peterborough, Parry Sound, Thunder Bay, Toronto, Wawa, and Windsor.

Changes to Ontario's rainfall patterns under global warming are expected to not only increase the risk of flooding, but also the risk of droughts. The potential cost associated with too much or too little precipitation in Ontario highlights the importance of understanding the characteristics, patterns and trends of precipitation in Ontario.

Climate change makes these events more likely; land use change worsens the consequences.

Contents

D1 What the data can and can't tell us

We know that more climate disruption is coming to Ontario, but how much is already here?

Precipitation is one the hardest parameters to measure.

In the search for this answer, precipitation is one of the most important parameters to measure. Changes in rainfall or precipitation affect a wide range of natural processes and human activities. However, precipitation is also one the hardest parameters to measure. Unlike temperature, rainfall is not spatially uniform. Most rainfall events occur as short, isolated and localized events, and their characteristics (intensity, duration, frequency) vary over space and time – making long-term trend analysis a challenge. Precipitation also occurs in many forms (liquid, solid and a mixture of both, such as freezing rain).

To really understand changes in precipitation, scientists need long-term, continuous data sets with good spatial coverage across the country. Ontario does not yet have these. In fact, Canada's precipitation monitoring network has been significantly reduced since budget cuts beginning in the 1990s reduced the number of observational stations across the country (see Figure D.1). Spatial coverage of climate stations is also uneven, with relatively few stations in northern Canada (see Figure D.2).

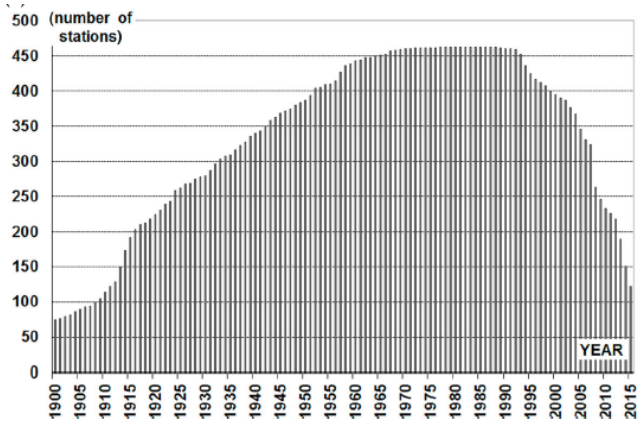


Figure D.1. The decline of the manual station network across Canada, with a minimum criteria of 20 years of valid observations.

Source: Mekis et al., 2018. Environment and Climate Change Canada (2018).

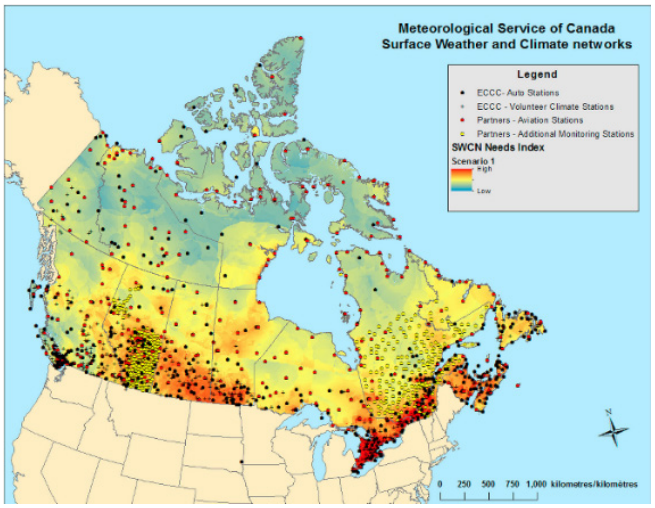


Figure D.2. Locations of the 1,735 surface weather stations across Canada with a Needs Index map in the background as of September 2016.

Source: Mekis et al., 2018. Environment and Climate Change Canada (2018).

D1.1 Annual rainfall is up

Environment and Climate Change Canada's (ECCC) available data shows that overall precipitation has increased across Canada over a 60-year time period (1950-2009); however, the changes vary across regions and over time (see Figure D.3). In Ontario, the greatest increases in precipitation (up to 50%, especially during the spring) have occurred in northwestern Ontario (e.g., near Thunder Bay), although southern Ontario has also experienced significant increases. At most stations, snowfall has decreased, especially in western Canada and from Ontario to the Maritimes. Only in southern Ontario, near the Great Lakes snow belt, has winter snowfall significantly increased by 10-30%.
Note: this data is based on a limited number of stations. Work is currently underway at ECCC to improve the quality and reduce the uncertainties in the data.

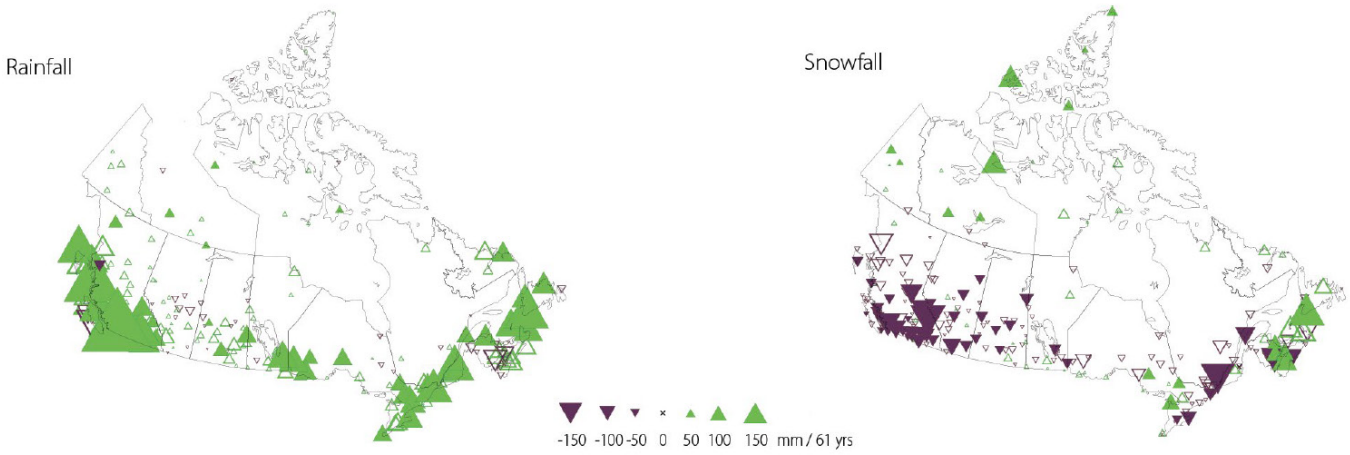


Figure D.3. Annual total rainfall and snowfall trends for 1950-2009 (compared to the average baseline period of 1961-1990). Upward- and downward-pointing triangles indicate positive and negative trends, respectively. Filled triangles correspond to trends significant at the 5% level. The size of the triangle is proportional to the magnitude of the trend. The legend may not include all sizes shown in the figure.

Source: Mekis and Vincent, 2011.

D1.2 Extreme events are hard to capture

Basic physics tells us that climate change will mean more extreme precipitation (high rainfall intensity and or duration). In general, warmer temperatures drive higher evaporation rates of surface water, and increase the amount of moisture that the air can hold. Every degree Celsius that the temperature rises, the air is able to hold (and drop) 7% more moisture, making storms more intense and severe. Overall, global warming will intensify the global hydrological cycle, leading to an increasing intensity of both wet and dry extremes and, by extension, associated hazards such as floods and droughts.

Every degree Celsius that the temperature rises, the air is able to hold (and drop) 7% more moisture.

Changes in extreme precipitation events are of particular concern for adaptation and infrastructure planning, especially in light of increased flood damages across Ontario. The spring 2017 flood events in Ontario and Quebec alone resulted in $223 million in insured damage. However, ECCC does not have good data on such events.

Extreme precipitation events have the highest spatial variability of all rainfall events. By definition, these events are rare – making analysis of changes in extreme events challenging. A much denser rainfall monitoring network would be required to accurately capture such extremes and estimate the expected frequency of such events (the return period). Long-term data records (minimum of 10 years) are also required to detect and evaluate trends in extremes. In Ontario, short-duration (2 hour or less), high-intensity rainfall events, are particularly poorly sampled by stations due to the issues mentioned above regarding the current observation network, and small spatial scale and variability of the storms. For example, much flooding is caused by small convective storms that may be no more than 10 kilometres across, while weather monitoring stations may be hundreds of kilometres apart.

In Ontario, short-duration (2 hour or less), high-intensity rainfall events, are particularly poorly sampled.

With respect to extreme precipitation in Canada, ECCC reports that due to the localized nature of extreme events and poor station density, it cannot yet reliably detect any regional pattern. To further assess this issue, the ECO examined whether some well-documented extreme storms in the Greater Toronto and Hamilton area were accurately measured by ECCC's network of monitoring stations.

D1.3 Storms are being missed by monitoring network

Table D.1 and Figure D.4 below summarize a series of nine extreme rainfall events in the Greater Toronto and Hamilton area. Only the 2013 Toronto storm was accurately measured by the ECCC network. The intensity of the eight other events were missed or under-represented.

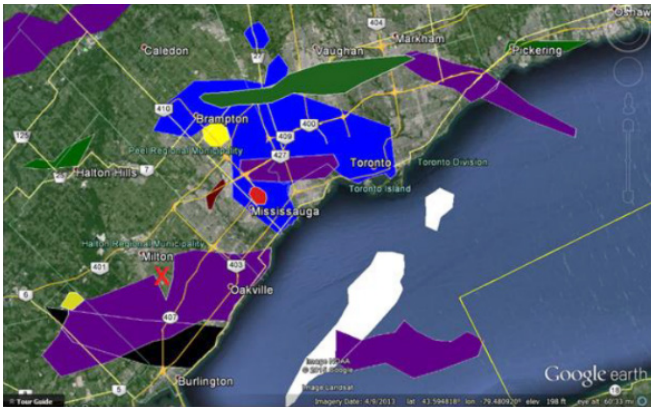


Figure D.4. Areal extent of extreme rainfall events in the Greater Toronto Area, 2000-2014. Each event is colour-coded. Black (August 4, 2014); blue (July 8, 2013); white (August 12, 2012); red (August 4, 2009); green (August 19, 2005); yellow (August 11, 2003); maroon (August 7, 2003); red 'X' (July 22, 2001); purple (May 12, 2000).

Source: Risk Sciences International (2018) Adapted from www.google.com/earth/download/ge/

Table D.1. Extreme rainfall events that are not well-documented, identified in Figure D.4, that occurred in the Greater Toronto and Hamilton area, 2000- 2014.

Source: Risk Sciences International (2018).

Storm Event (corresponds to Figure D.4)	Hamilton RBG CS Daily Total (mm)
August 4, 2014 (Black-coloured area)	0.0
July 8, 2013 (Blue-coloured area)	0.0
August 12, 2012 (White-coloured area)	3.4
August 4, 2009 (red-coloured area)	13.8
August 19, 2005 (green-coloured area)	20.6
August 11, 2003 (yellow-coloured area)	0.2
August 7, 2003 (maroon-coloured area)	0.0
July 22, 2001 (red 'x' on map)	21.4
May 12, 2000 (purple-coloured area)	25.8

As shown in Table D.1, ECCC networks missed the most extreme rainfall during the major Burlington storm of August 2014, which flooded approximately 6,000 properties. ECCC stations, identified by triangles, are not near the maximum area of rainfall (see Figure D.5).

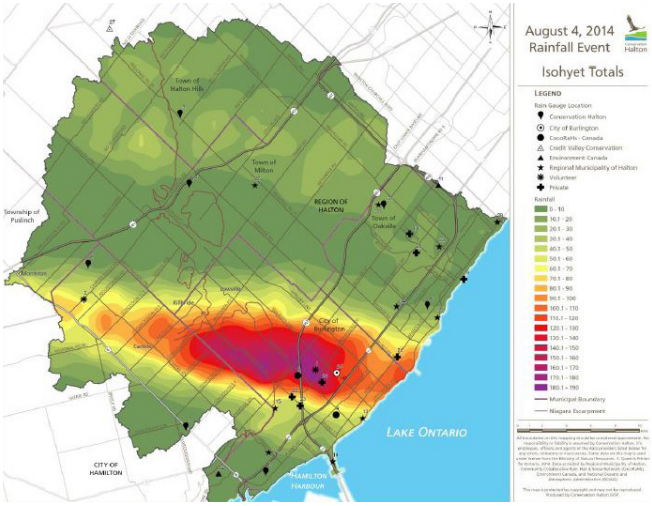


Figure D.5. August 4, 2014 storm event analysis. No ECCC stations would have captured this event.

Source: Conservation Halton, 2015.

Thus, we cannot expect the current monitoring network to accurately reflect the extreme precipitation events that are occurring in Ontario.

Thus, we cannot expect the current monitoring network to accurately reflect the extreme precipitation events that are occurring in Ontario.

D2 Insights from across the border

American states, just across the border, have a much greater density of weather observation stations than Ontario does, and are therefore likely to have better data on recent climate extremes.

Many U.S. studies show statistically significant increasing trends in rainfall extremes, particularly in the states directly bordering southern Ontario (see Figure D.6). In particular, the largest increases in the frequency and intensity of daily precipitation events from 1958 to 2016 have been observed in the Midwest (42%) and Northeast U.S. (55%). The ECO knows of no reason why these trends in annual precipitation would create discontinuities at the international border. It seems more plausible that the reported discrepancies at the border are due to Canada's much weaker observation network.

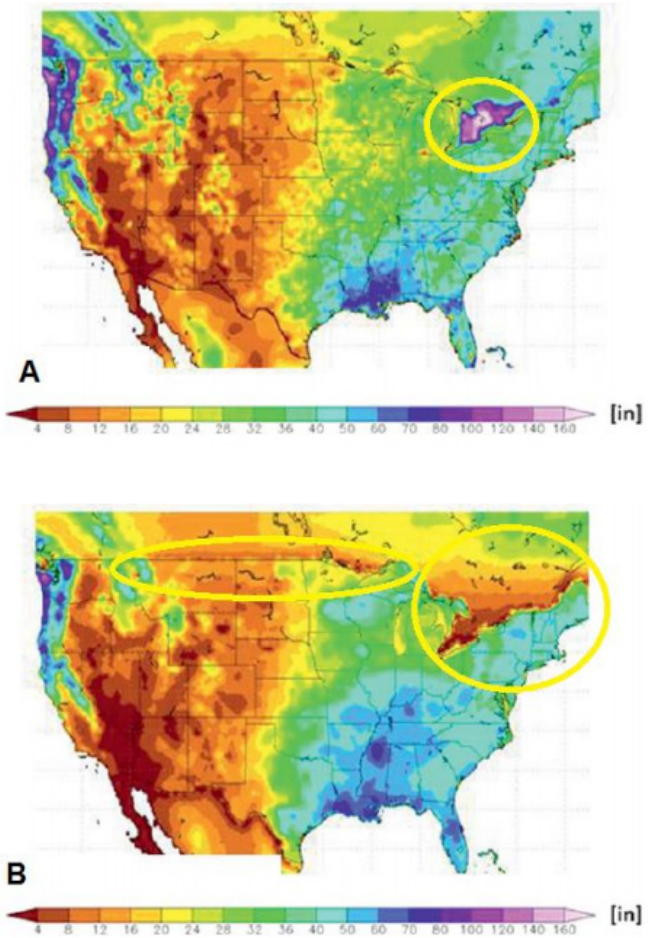


Figure D.6. NASA 'Land Data Assimilation System' accumulated annual precipitation data for (a) 2012 and (b) 2002. Note significant discontinuities across the Canada/U.S. border as highlighted.

Source: Gronewold et al. (2018).

D3 What's ahead: future precipitation

As temperatures continue to rise, global warming is expected to intensify the global hydrological cycle, leading to an increasing intensity of both wet and dry extremes and, by extension, associated hazards such as floods and droughts.

An increasing intensity of both wet and dry extremes.

Further insight into the future of precipitation in Ontario have been provided by climate models.

Figure D.7 presents the projected changes in Ontario's precipitation for two time periods, 2050s (2041–2070) and 2080s (2071–2100) under three climate scenarios. The three scenarios (known as Representative Concentration Pathways or RCP 2.6, 4.5, and 8.5) are adopted from the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. The RCPs represents a range of possible changes (i.e., scenarios) in future GHG emissions. Based on the results of these models, it is likely that the entire province will experience changes in total precipitation under all three scenarios. Overall increases of up to 180 mm of precipitation annually may occur in Ontario by the 2080s. Across the province, more precipitation is projected in the winter, though this could vary greatly by region (the provincial range is from -4 mm to 70 mm relative to historical levels), and much of this will be rain, not snow. Summers are projected to be drier on average (the provincial range is from -50 mm to 40 mm relative to historical levels) by the 2080s. These changes will have multiple impacts, including on water supplies, agriculture, natural resources, stormwater, flooding, and infrastructure.

More precipitation in the winter and much of this will be rain. Summers are projected to be drier.

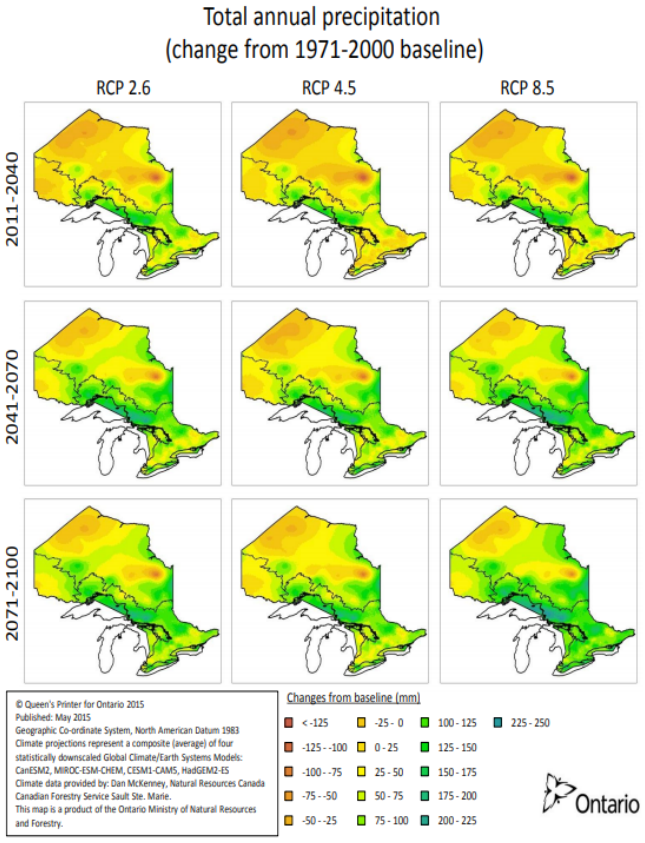


Figure D.7. Projected changes in total annual precipitation in Ontario from 1971–2000 baseline values for representative concentration pathways (RCP) 2.6, 4.5, and 8.5 over three 30-year time frames (2011– 2040, 2041–2070, and 2071–2100). RCP 2.6 reflects significantly reduced global emissions; RCP 4.5 reflects a moderate reduction in global emissions; RCP 8.5 is the business as usual scenario with no emission reductions. Data are derived from the composite AR5 model and statistically downscaled for the province. The three primary watersheds in Ontario are delineated on the map.

Source: Ministry of Natural Resources and Forestry (2015)

Better data and better analysis will help scientists make more accurate predictions of long-term climate trends (i.e., long-term annual and seasonal changes from normal/baseline).

D4 Flooding in Ontario: not just due to climate change

Climate change is not the only factor leading to increased costs from flood damage in Ontario. Land use changes also have a significant impact on flooding. In forests, little rainfall runs off as stormwater due to high rates of infiltration (i.e., absorbent soils, trees, and other vegetation) and evapotranspiration. In these natural areas, on average, only 10% of total rainfall becomes runoff. In contrast, 55% of the rain that falls in highly urbanized areas (i.e., paved ground) becomes runoff. Runoff flows reach peak levels quicker, occur at higher levels and last longer, often overwhelming stormwater infrastructure. Flood losses can also increase due to the increased prevalence of finished basements that contain electronics, appliances and other valuables. Substantial underfunding of municipal stormwater management is also contributing to flood losses.

Land use changes also have a significant impact on flooding.

The continuing loss of wetlands in southern Ontario further worsens flood losses. Researchers at the University of Waterloo's Intact Centre on Climate Adaptation found that in the event of a major storm, the financial costs of flooding in rural and urban areas would be 29% and 38% lower, respectively, if wetlands were kept in their natural state versus being lost due to development. In southern Ontario, at least 72% of the original wetlands have been lost to development (e.g., agriculture, urban sprawl and other land conversion).

Ontario forecast that the population of the Greater Golden Horseshoe will increase by more than four million people by 2040. This increase in urbanization, combined with climate change, wetland loss, and inadequate stormwater management could dramatically increase the frequency and intensity of urban flooding.

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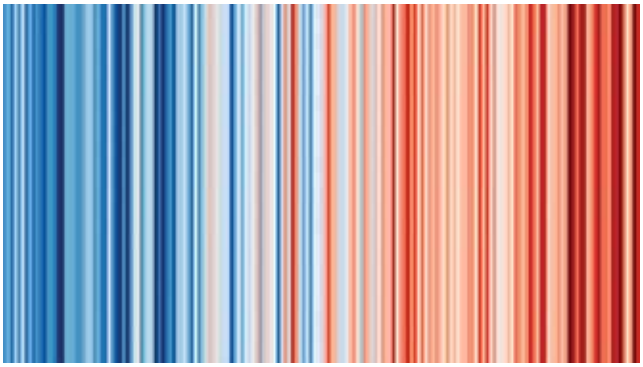
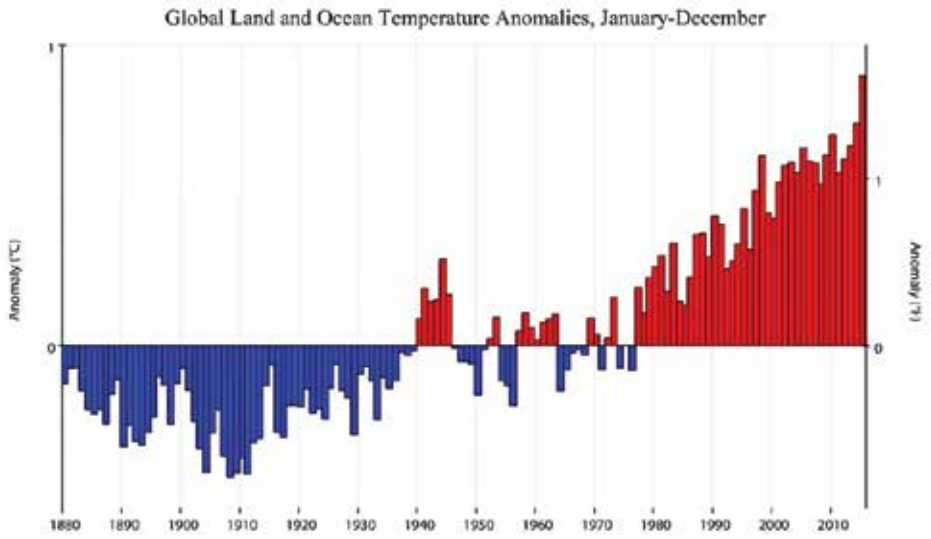
Our twentieth century "normal" is gone.



Annual temperatures in Toronto from 1841-2017.
The colour scale goes from 7.6˚C (dark blue) to 10.8˚C (dark red).

Source: National Centre for Atmospheric Science

It is too late to just talk about the climate, what counts now is action.



Source: National Oceanic and Atmospheric Administration (2018).

If you're younger than 33, you've never experienced a month in which the average surface temperature of Earth was below the average of the twentieth century.

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