Climate Vision

Climate Change Progress Report

Technical Appendix

Ontario

Technical Appendix A

Introduction

This technical appendix provides details on the province's greenhouse gas (GHG) emissions and changes in emission levels since 1990.[1] In addition, it also provides an update on the province's forecasted emission levels out to 2020, including the impact of policies on progress toward the province's emission targets.

How Ontario Measures its GHG Emissions

Ontario's definition of GHG emissions aligns with the definitions used to prepare Environment Canada's National Inventory Report 1990–2010: Greenhouse Gas Sources and Sinks in Canada (NIR), published in April, 2012. Each year, Environment Canada submits its updated NIR to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat. Historical GHG emissions in this progress report are taken from the latest NIR, which covers the period from 1990 to 2010. The data cover most activities in Ontario's economy that influence GHGs but do not include impacts relating to land use and forestry at this time. The NIR is organized into numerous categories that are defined by UNFCCC reporting protocols and therefore do not match categorizations by other sources of economic, industrial, energy and emissions data. For this appendix, the categories are rolled up into six key economic sectors (see Table 1).

TABLE 1
ONTARIO EMISSION SECTOR DESCRIPTIONS

ECONOMIC SECTOR	DESCRIPTION
Transportation	Emissions from the consumption of fossil fuels such as diesel, gasoline and propane consumed by passenger and commercial vehicles including road, rail, marine and air travel
Industry	Emissions from industrial processes and the use of fossil fuels such as coke, natural gas and coal are produced from a range of industries including mining, oil and gas extraction, manufacturing, mineral and chemical production, construction and paper and wood products production
Buildings	Emissions from the use of fossil fuels such as natural gas in residential, commercial and institutional buildings for heating and water
Electricity	Emissions from electricity and heat generation produced from the combustion of fossil fuels such as coal and natural gas
Agriculture	Emissions generated by enteric fermentation, manure management and fertilizer application
Waste	Emissions generated by solid waste disposal on land, wastewater handling and waste incineration

NB: Emissions from the pipeline transportation of petroleum products are included in the Industry sector.

1 All figures in this appendix are rounded, which may therefore not produce the exact results indicated for totals, ratios, etc.

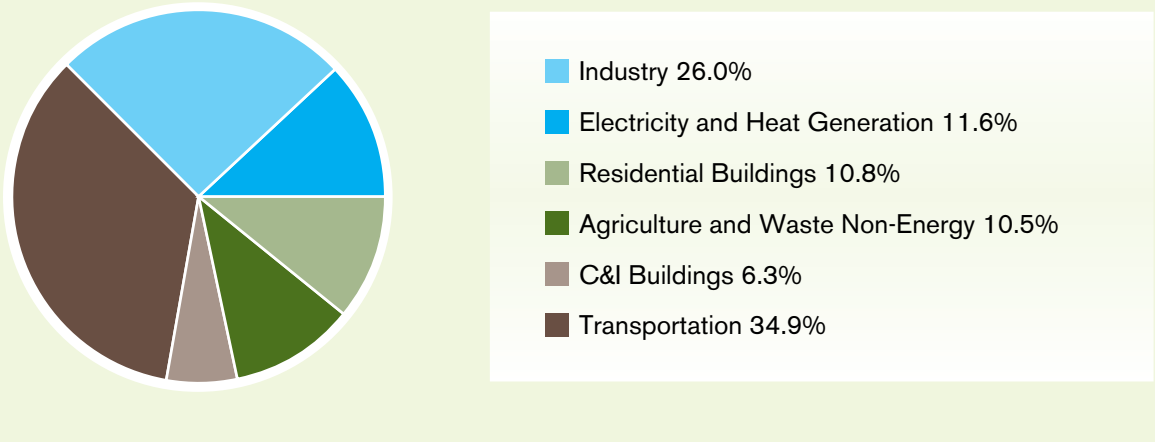
Changes in NIR

Environment Canada is continually working to refine the data and methods used to estimate national and provincial emissions. These refinements often lead to re-calculation of GHG emission estimates for the whole time period of the NIR, dating back to 1990. This means that our 1990 base year emissions and historical trends can change from year to year, influencing our emission forecasts and the assessment of our progress to targets. These changes are well documented in the NIR and are typically minor but in recent years, some changes in the industrial sector methods have had a pronounced impact on Ontario emission estimates.

Sources of Ontario's GHG Emissions

GHG emissions result from virtually all aspects of Ontario's society and economy but primarily from how we produce and consume energy. Ontario's 2010 emissions are estimated to have been 171 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq), with sectoral shares shown in Figure 1.

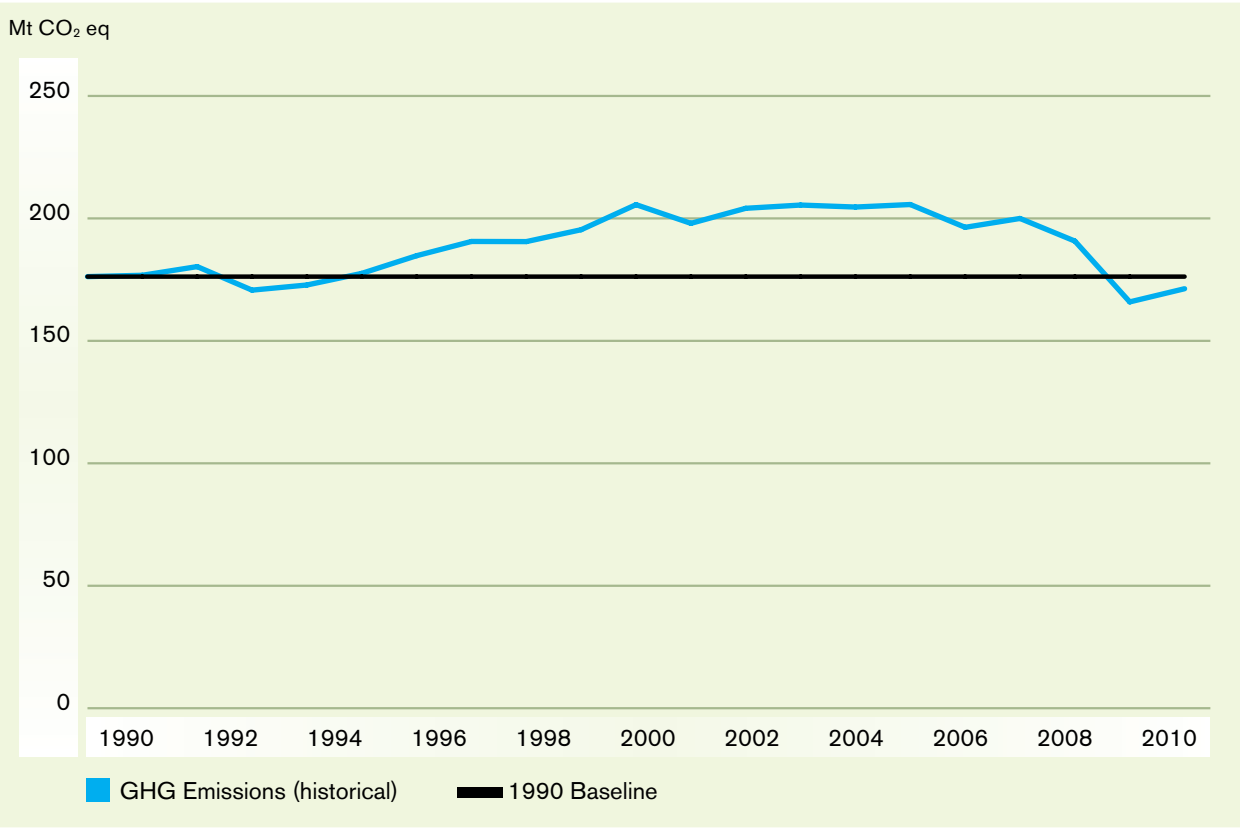
FIGURE 1
2010 GHG EMISSIONS BY SECTOR



Long-Term Trends in Ontario's Emissions (1990–2010)

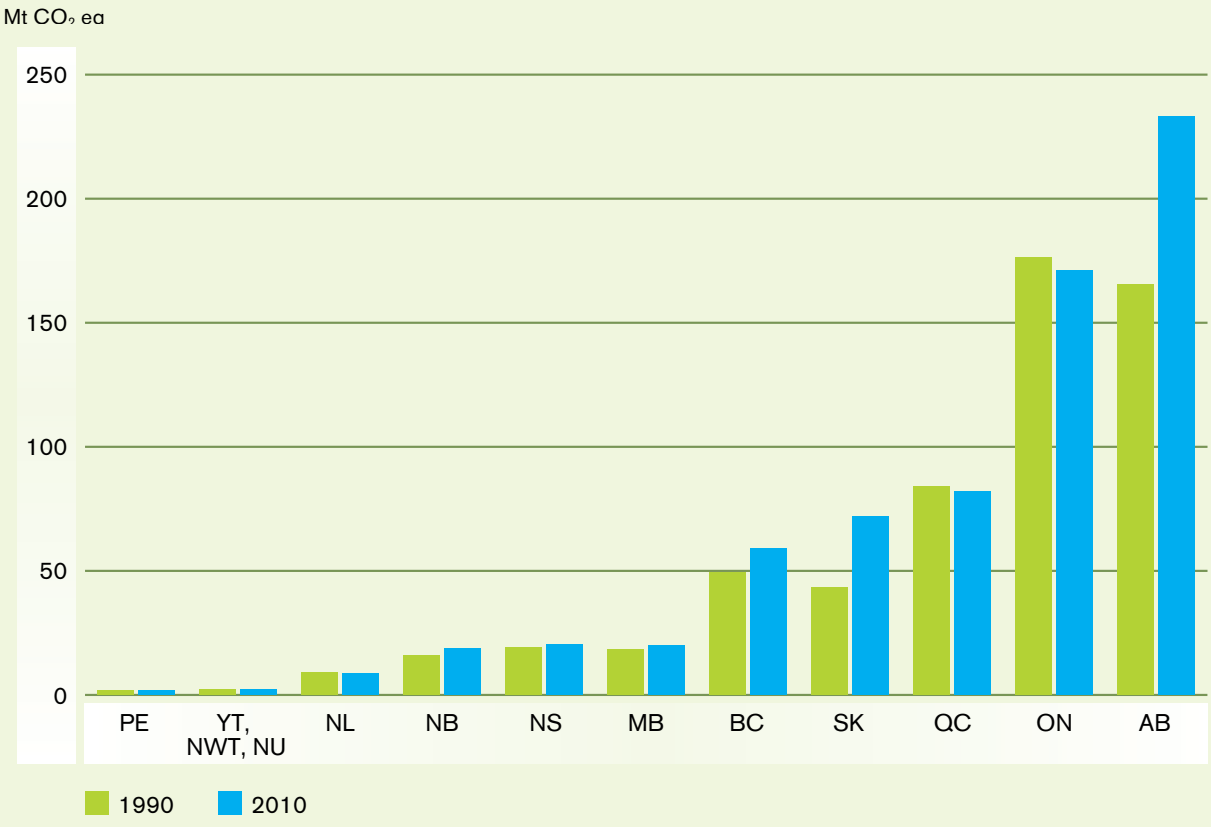
Between 1990 and 2010, Ontario's total annual emissions dropped by three per cent, from 176 Mt of CO_2 eq to 171 Mt of CO_2 eq. Figure 2 shows that, while total emissions increased fairly steadily in the first half of this period, more recent annual emission levels have fluctuated in response to changes in the economy, weather, energy demand and technologies used by industry, electricity generation, transportation, and consumer products.

FIGURE 2
ONTARIO'S GHG EMISSIONS, 1990–2010



In contrast to Ontario's stable to declining emissions, the national trend is increasing emissions. In 2010, Canada's GHG emissions totalled[2] 695 Mt CO_2 eq, which represents an increase of 18 per cent since 1990. However, increases since 1990 have varied significantly across Canada. Similar to Ontario, Quebec's emissions decreased by two per cent while Saskatchewan realized the highest increase in emissions (67 per cent) (see Figure 3). In absolute emissions since 1990, the most growth has occurred in Alberta (68 Mt) while the greatest decrease has occurred in Ontario (5 Mt).

FIGURE 3
TERRITORIAL AND PROVINCIAL GHG EMISSIONS, 1990 AND 2010



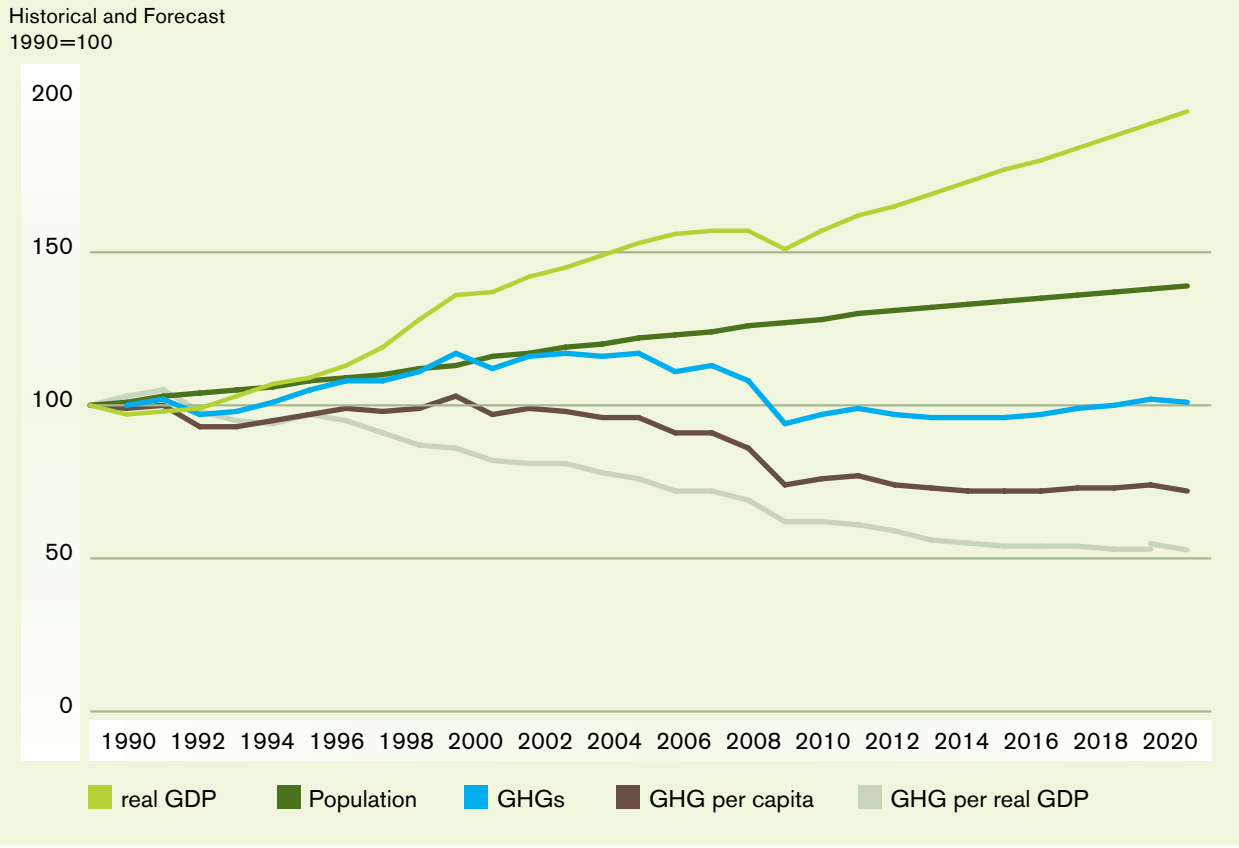
2 In June 2012, British Columbia released their Greenhouse Gas Inventory Report 2010, in which they identified a significant discrepancy in the "Fossil Fuel Production and Refining" line item of the 1990-2010 NIR. As the discrepancy was due to a data automation issue that was not identified before the NIR was published, this appendix uses a revised estimate for B.C. (and therefore total Canadian) emissions: an increase of 3037.5 kiltotonnes CO2 eq in 2010.

TABLE 2
EMISSION CHANGES BY SECTOR (ONTARIO)

ECONOMIC SECTOR	DESCRIPTION
Transportation 1990: 45.5 Mt 2010: 59.8 Mt Change: +31%	Road transportation was responsible for the greatest increase in Ontario's emissions between 1990 and 2010. This long-term increase can be attributed to 30 per cent growth in the on-road vehicle population and the increased consumer preference for SUVs, vans and pick-ups (which more than doubled over this period) over smaller passenger vehicles. Higher emissions also reflect the national trend toward just-in-time delivery, requiring more transportation per product.
Industry 1990: 63.2 Mt 2010: 44.5 Mt Change: -30%	Significant improvements in energy efficiency since 1990 have resulted in greenhouse gas reductions as industries responded to increased energy costs and global competitiveness.
Buildings 1990: 26.3 Mt 2010: 29.2 Mt Change: +11%	Long-term increases in this sector are due to economic changes and population growth. Emissions from commercial and institutional buildings have increased 18 per cent due to a shift in the provincial economy from a manufacturing base to a diversified service industry including finance, insurance and real estate. Residential emissions increased by seven per cent while the population increased by 28 per cent.
Electricity 1990: 25.1 Mt 2010: 19.8 Mt Change: -21%	Emissions in Ontario's electricity and heat generation sector grew between 1990 and 2000 (an increase of approximately 70 per cent). Significant decreases after 2007 (40 per cent by 2010) have been achieved primarily through the phasing out of coal-fired generation, increasing of renewables and conservation initiatives in the industrial, residential and commercial sectors.
Agriculture 1990: 10.0 Mt 2010: 10.3 Mt Change: +4%	Emissions from agriculture have remained relatively constant with slight fluctuations resulting from a combination of changing tilling and nutrient management techniques and livestock levels.
Waste 1990: 6.2 Mt 2010: 7.6 Mt Change: +24%	Waste emissions increased primarily due to increases in landfill gas which is generated from waste disposed in landfill sites both recently and in past decades.

It is important to note that, while Ontario's total emissions decreased by three per cent between 1990 and 2010, both emissions per capita and emissions for each dollar of real Gross Domestic Production (GDP) have declined by a much greater amount (24 percent and 38 per cent respectively; see Figure 4). This indicates an ongoing trend towards a lower-carbon economy and society, which our modelling suggests will continue.

FIGURE 4
EMISSION INTENSITIES INDICES



Ontario's intensities are significantly lower than most provinces. Table 3 shows 2010 emissions per capita and per dollar of real GDP across Canada.

TABLE 3
PROVINCIAL/TERRITORIAL GHG INTENSITIES

PROVINCE/ TERRITORY	GHG INTENSITY (Mt/$B GDP)	RANK (GHG INTENSITY)	GHG PER CAPITA (t/CAPITA)	RANK (GHG PER CAPITA)
YT, NWT, NU	0.18	1	18.99	7
QC	0.34	2	10.37	1
ON	**0.37**	**3**	**12.95**	**2**
BC	0.41	4	13.04	3
MB	0.53	5	16.05	5
PE	0.57	6	13.67	4
NL	0.59	7	17.33	6
NS	0.79	8	21.54	8
NB	0.88	9	24.68	9
AB	1.55	10	62.70	10
SK	2.12	11	69.05	11

NB: GDP is measured in 1997 dollars.

Short-Term Trends in Ontario's Emissions (2007–2010)

Between 2007 (when the Climate Change Action Plan was first released) and 2010, Ontario's emissions decreased by 14 per cent – a decline of 29 Mt. Table 4 shows emissions decreased across all major sectors. The electricity sector saw a 40 per cent reduction in emissions, the largest decrease. The second largest decrease was in the industrial sector where emissions fell by 23 per cent. These reductions are largely attributable to reduced coal-fired electricity generation and a decline in both output and emission intensity in energy-intensive industries. Both residential and commercial buildings also reduced their emissions from heating, despite increases in total floor space. This is due to ongoing successful natural gas demand management programs, and the residential retrofit program; however, economic activity likely affected these emissions as well.

TABLE 4
CHANGES IN ONTARIO'S EMISSIONS (2007–2010)
(MT CO_2 EQ)

SECTOR	2007	2010	VARIATION (2007–2010)
Transportation	58.0	59.8	3%
Industrial	58.0	44.5	-23%
Buildings	33.0	29.2	-12%
Electricity	33.0	19.8	-40%
Agriculture	10.0	10.3	4%
Waste	7.9	7.6	-4%
Total	**200.0**	**171.3**	**-14%**

Emission Modelling Overview

Reporting on the progress of Climate Change Action Plan initiatives and projecting future GHG emissions are essential to understanding Ontario's progress towards meeting its action plan targets. It should be noted, that emission forecasts are only one measure of progress on climate change actions. Decarbonization is achieved through steady, ongoing reductions in the key drivers of energy use (particularly fossil fuels) and non-energy emissions. Incremental progress in these areas is best assessed by looking at a variety of indicators – quantitative ones like emission forecasts, but also changes in emission intensities, building densities, vehicle kilometres travelled, etc. – along with qualitative assessments of the nature and resilience of socioeconomic changes. Finally, most of the important initiatives (public transit infrastructure, building energy efficiency, vehicle efficiency improvements, and land use) take decades until their peak impacts are felt.

Ontario's approach to modelling GHG emissions is updated periodically to incorporate the latest data available and refinements based on best practices. In addition, the projections of emission reductions are adjusted as required to incorporate changes to programs or policies. This modelling uses the most recent NIR data (April 2012) from Environment Canada and economic and demographic forecasts from February 2012 by Informetrica.

This information was used to create:

1. A Business-as-Usual (BAU) projection – a projection that assumes underlying historical emission trends continue (excluding the anticipated future impact of emission reduction initiatives, both planned and already underway), while taking account of the current economic outlook for Ontario;

2. A Climate Change Action Plan projection – a projection that includes the anticipated future impact of emission reduction initiatives (both those that are underway and those that are committed to and sufficiently developed to reasonably estimate their impacts).

Third-Party Validation

To provide confidence in the province's long-term forecasts, Ontario has had its emissions forecasting methodology and assumptions validated by an independent third party. In 2009, Ontario was the first jurisdiction to undertake a validation of its forward-looking emission reduction forecasts. The process of completing a validation is intended to ensure that the methodologies, data sources and assumptions used to develop the projected GHG emissions under the action plan are reasonable and align with best practices where available. For this report, Ontario retained Navius Research Inc., who concluded that Ontario's estimates are a fair representation of those expected using current best practices in GHG emissions forecasting and evaluation of GHG mitigation programs (see Appendix C for assurance statement).

Updated Emissions Projection

Since the release of the last climate change progress report, the province's emission forecasting model has been updated to reflect the best available information.

The government is now projecting that the suite of initiatives will achieve approximately 90 per cent of the reductions needed to meet the 2014 target. The forecasts show a slight improvement over those in the last report (see Table 5). Changes in forecasted emissions reflect revisions to modelling[3], changes to the BAU scenario (see below) and new data on program participation and effectiveness.

TABLE 5
PROGRESS TO TARGETS

2012 REPORT	2014	2020
Projected Reductions (Mt)	31	42
Progress to Target	91%	60%
Gap (Mt)	3	28

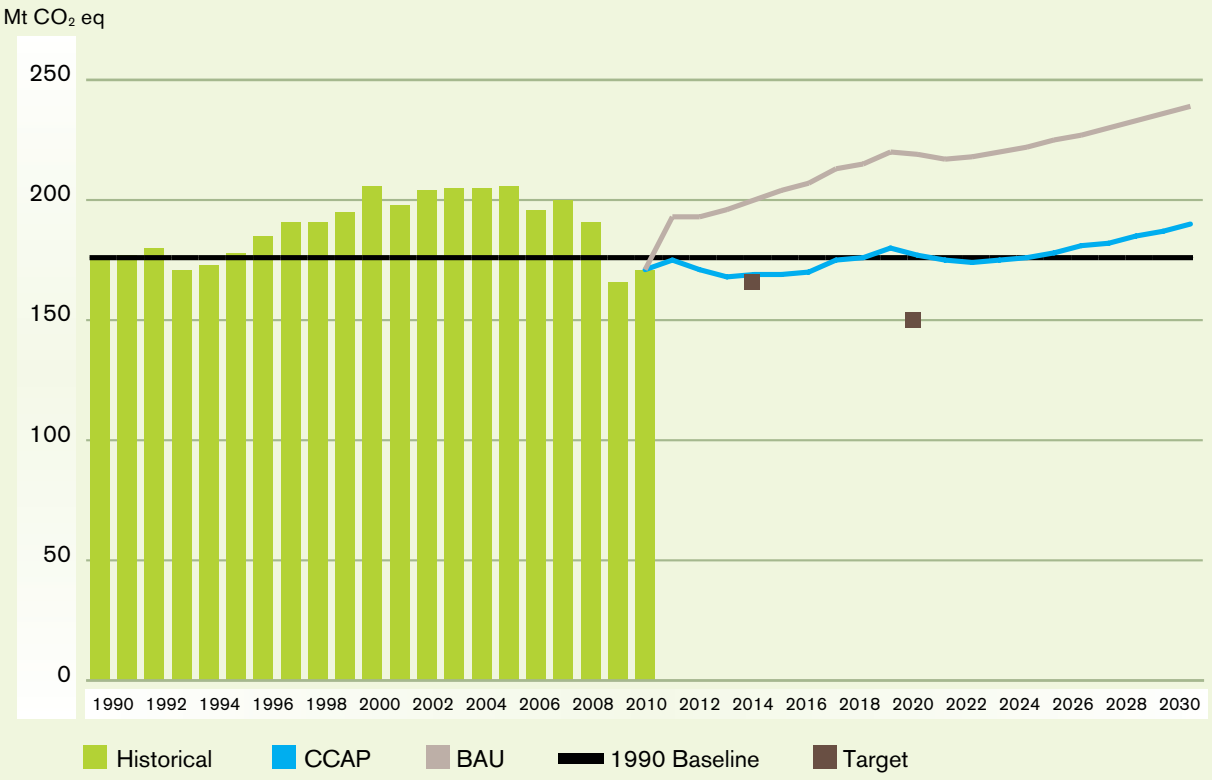
2011 REPORT	2014	2020
Projected Reductions (Mt)	27	39
Progress to Target	88%	57%
Gap (Mt)	4	30

Updating the BAU

The province's BAU scenario has been updated to reflect more recent emission and energy use data, revisions to historical data from Environment Canada and Natural Resources Canada, revised economic and demographic forecasts and refinements to the underlying model.

3 The most significant methodological change was in how ethanol in blended gasoline is both reported and forecast. In the last report, the NIR data used did not account for ethanol in motor gasoline and the model did not forecast emission reductions from higher ethanol blending due to Ontario's ethanol regulation (although in place at the time). A change to using an average of historical emission factors of coal in generating electricity also significantly increased the BAU emissions from electricity, as recommended by the validator.

FIGURE 5
FORECASTED GHG EMISSIONS



Initiative Impacts

The province's suite of initiatives represent a combination of distinct GHG reduction efforts, such as provincial regulation requiring methane from landfills to be captured, and clusters of related efforts aimed at achieving a common goal, such as the phase-out of coal-fired electricity generation and related renewable generation and conservation activities. The initiatives cross all of the emission sources and economic sectors and represent a blend of short-, medium- and long-term emission reductions. The initiatives include activities that are both within and outside the direct control of the Ontario government and include federal policies that are closely interrelated with provincial initiatives.

TABLE 6
EMISSION REDUCTIONS BY INITIATIVE (SECTOR TOTALS)

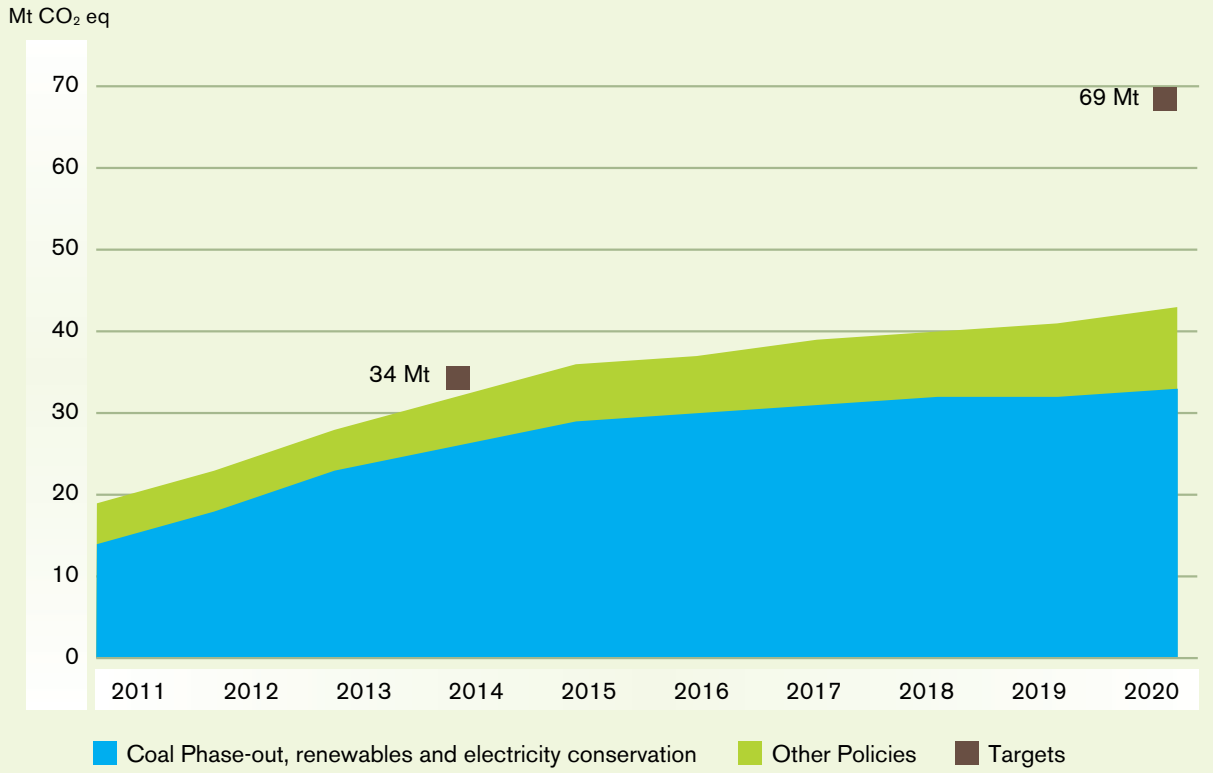
SECTOR	INITIATIVE	PROJECTED REDUCTIONS (MT) 2014	2020
Transportation	• The Big Move regional transportation plan and Growth Plan for the Greater Golden Horseshoe[4] • Passenger vehicle efficiency regulations • Freight truck speed limiter regulation • Municipal hybrid bus purchase and Green Commercial Vehicle Programs • Ontario ethanol regulation	1.9	3.9
Industry	• Natural gas demand side management programs	0.6	1.0
Buildings	• The Growth Plan for the Greater Golden Horseshoe • Natural gas demand side management programs • Building Code changes	1.6	2.9
Electricity	• Long-Term Energy Plan: Coal phase-out; the Feed-In Tariff; residential, commercial and industrial conservation programs; and related electricity policies	24.8	31.6
Agriculture and Waste	• Biogas Financial Assistance Program • Landfill gas capture regulation	1.8	2.0
	All initiatives	30.6	41.3

NB Emission reductions for all initiatives together may differ from the sum of individual initiative reductions due to interaction between them.

Phasing out coal-fired electricity generation and replacing it with renewable power, natural gas, refurbished nuclear and energy conservation has by far the largest impact in the near future (see Figure 7). After 2020, however, impacts from initiatives in the transportation and building sectors will increase relative to those from the electricity sector because of the time required for construction (transit projects) and turnover (vehicle fleets, housing stock).

4 The regional transportation plan is an official long-term plan, produced by Metrolinx. However, capital projects are approved and funded individually as the plan is implemented over 25 years and may be subject to change. Therefore, modelling for this initiative is inherently more uncertain than for other initiatives.

FIGURE 7
REDUCTIONS BY SOURCE



Uncertainty

The reductions presented in this report, linked to the government's GHG emission reduction measures, are based on a single set of economic, demographic, energy, and policy assumptions. As with any modelling of this kind, there are significant uncertainties inherent in this projection.

As a rough example, if in 2020 both real GDP and population were one per cent higher than forecasted, the projected non-electricity emissions would be approximately 1.5 Mt greater (almost one per cent of non-electricity emissions). This change is a generalized effect. The increase could be significantly higher or lower depending, for example, on whether energy-intensive manufacturing output is higher than the service sector. Electricity emissions are sensitive to weather – more frequent hot summer afternoons (especially combined with higher GDP) would increase emissions much further.

Technical Appendix B

Status of Climate Ready Actions

#1 REQUIRE CONSIDERATION OF CLIMATE CHANGE ADAPTATION

Lead Ministry: Ministry of the Environment (MOE)

2011	Released Climate Ready - Established strategic framework for adaptation in Ontario. Established and coordinated OPS Climate Modelling Collaborative (ongoing).
2012	Provided ongoing technical and policy assistance to partner ministries (12), worked to identify gaps/needs for the Ontario Public Service. Explored the use of climate indicators to get a better sense of observed local climate impacts and benchmarks to measure progress on adaptation.
2013	Working towards establishment of a standardized, risk-based approach to considering adaptation in policies and programs. Working through the Centre for Learning & Development to train OPS staff in climate impacts and adaptation and/or refer public servants to courses. Commissioning new climate research (climate modelling, indicators, economic impacts). Working to foster new policy initiatives and assisting in the review of existing policies and programs. Supporting the development of risk-management tools.
2014 and beyond	Ministries mainstreaming adaptation into policies and programs as standard practice.

#2 ESTABLISH A CLIMATE CHANGE ADAPTATION DIRECTORATE

Lead Ministry: MOE

2011	Determined appropriate mix of technical, policy, research and scientific support staff necessary to meet adaptation needs.
2012	Dedicated staff in MOE coordinated adaptation research and expertise across government.
2013	Dedicated staff in MOE coordinating adaptation research and expertise across government.
2014 and beyond	Reporting on progress and success of Climate Ready actions. Identifying new targets and areas of opportunity for Ontario to increase adaptation planning and resilience.

#3 PROMOTE WATER CONSERVATION

Lead Ministry: MOE and Ministry of Economic Development and Innovation (MEDI)

2011	The Water Opportunities Act proclaimed in 2010 to make Ontario a leader in the development and sale of water conservation and treatment technologies. Established Water Technology Acceleration Project and launched Showcasing Water Innovation.
2012	Showcasing Water Innovation Program fund announced – $17 million committed over three years. Announced WaterSense in Ontario – a water efficiency labelling program for consumer products.
2013	Showcasing Water Innovation Program will continue to fund leading-edge, innovative and cost-effective solutions for managing water, wastewater and stormwater. Developing initial regulations, e.g., municipal water sustainability plans and water conservation plans by public agencies.
2014 and beyond	Tracking and reporting on new examples of sustainable infrastructure, conservation planning and technologies to solve water, wastewater and stormwater infrastructure challenges. Developing additional regulations, e.g., standard information on a municipal water bill. Continue implementation, sharing best practices and lessons learned.

#4 REVIEW THE ONTARIO LOW WATER RESPONSE PROGRAM

Lead Ministry: Ministry of Natural Resources (MNR)

2011	
2012	Scanned and digitized historic groundwater levels (1966-1980) to lengthen PGMN period of record.
2013	Revising methodologies to select monitoring wells, mapping groundwater drought susceptibility and streamlining program delivery.
2014 and beyond	Projects to be determined by steering committee. Developing options for real-time groundwater levels and enhancing temperature records at some locations.

#5 CONSIDER CLIMATE CHANGE IMPACTS IN THE BUILDING CODE

Lead Ministry: Ministry of Municipal Affairs and Housing (MMAH)

2011	MOE started working with MMAH and industry stakeholders to promote changes to the Building Code that would increase resiliency in light of a changing climate. Public, technical and stakeholder consultations on potential changes to the Code took place in 2010-2011.
2012	Currently reviewing input received on potential changes to the next edition of the Building Code. These changes potentially include updated climatic data on which design parameters for buildings are determined.
2013	Implementation of any new Building Code requirements apart from major changes to the Building Code which justify a "new edition", interim amendments to the Building Code can be made as required. This will allow the Building Code to adopt new scientific and technical information as it becomes available for the design of new construction.
2014 and beyond	Ongoing implementation of any new Building Code requirements.

#6 UNDERTAKE INFRASTRUCTURE VULNERABILITY ASSESSMENTS

Lead Ministry: Ministry of Infrastructure (MOI) chose three high value sites for Climate Change engineering vulnerability assessment

2011	Completed the assessments and final report.

Lead Ministry: MOE

2011	*Complementary Actions* Assessed intensity, duration, frequency (IDF) curves for climate change to support risk management and decision-making.
2012	*Complementary Actions* Supported the City of Welland to update the local rainfall IDF curve and to complete a climate change engineering risk assessment for wastewater, combined sewage and stormwater infrastructure on the city-wide scale.
2013	*Complementary Actions* Review of wastewater case study for potential broad implementation by municipalities across Ontario (mandatory or voluntary). Other asset types like electricity infrastructure and roadways will be assessed as case studies.
2014 and beyond	*Complementary Actions* (TBD) Ontario municipalities will be undertaking risk assessment for water, wastewater and stormwater systems. Other asset types like electricity infrastructure and roadways will be assessed as case studies.

#7 BUILD CLIMATE CHANGE ADAPTATION INTO ONTARIO'S 10-YEAR INFRASTRUCTURE PLAN

Lead Ministry: MOI

2011	Released Building Together, the province's long-term infrastructure plan, on June 24, 2011. A key part of the plan is the requirement that asset management plans prepared by the province or transfer payment partners such as universities, municipalities and social service agencies will have to show how climate change adaptation was considered in the project design.
2012	Implementation will continue over the ten-year span of Building Together.
2013	Implementation will continue over the ten-year span of Building Together.
2014 and beyond	Implementation will continue over the ten-year span of Building Together.

#8 INTEGRATE CLIMATE CHANGE IMPACTS INTO THE ENVIRONMENTAL ASSESSMENT PROCESS

Lead Ministry: MOE

2011	
2012	Draft EA Guidance under development.
2013	Once complete, draft EA Guidance to be posted on Environmental Registry for public consultation. EA Guidance to be finalized and publicly released following consultation period.
2014 and beyond	EAs in Ontario may now include references to consideration of future climate impacts. New climate projections will be incorporated into EA review as appropriate.

#9 INTEGRATE ADAPTIVE SOLUTIONS INTO DRINKING WATER MANAGEMENT

Lead Ministry: MOE

2011	Consultated on amendments of Director's Technical Rules to enable consideration of Climate Change projections in Assessment Reports. Released MNR sponsored Guide for Assessment of Hydrologic Effects of Climate Change in Ontario to be used in water budget / source water protection plans.
2012	Training on integrating climate change information into drinking water protection. Climate change integration pilots completed.
2013	Risk Management and Climate Change Evaluation Process for Drinking Water Quantity Risk finalized.
2014 and beyond	Adaptation will be incorporated into the Assessment Reports and source protection plans in high risk areas.

#10 DEVELOP GUIDANCE FOR STORMWATER MANAGEMENT

Lead Ministry: MOE

2011	Supported the City of Hamilton to develop municipal document for stormwater source control including climate change adaptation measures in planning/approval of industrial/business parks.
2012	Hamilton's municipal guidance document completed in Spring 2012 with municipal training anticipated for mid-2012.
2013	Reviewing for potential broad implementation across Ontario.
2014 and beyond	Potentially expanded number of Ontario municipalities will be incorporating stormwater source control as adaptation measures in planning/approval of industrial/business parks, as appropriate.

#11 STRENGTHEN THE WINTER ROAD NETWORK

Lead Ministry: Ministry of Northern Development and Mines (MNDM)

2011	Winter road 2011-12 season ended March 15, 2012; Roads opened to light traffic January 2012. Full loads February 15 to March 15, 2012. Construction and operation of 3,000 km winter road system that links 30 communities to provincial highway or rail system.
2012	Will contribute up to $4.7 million in 2012-13 to help isolated communities build winter roads. Some First Nation communities have completed studies to move winter roads to high ground for future all season roads.
2013	Continue to work with Federal Government and First Nation communities towards moving winter roads to high ground winter roads and future all season roads. MNDM will continue to provide financial assistance towards the cost to construct winter roads.
2014 and beyond	Continue to work with Federal Government and First Nation communities towards moving winter roads to high ground winter roads and future all season roads. MNDM will continue to provide financial assistance towards the cost to construct winter roads.

#12 PROTECT ANIMAL HEALTH

Lead Ministry: Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)

2011	Background policy development for regulations under Animal Health Act for the reporting of diseases spread by insect vectors and migratory birds affected by climate change (e.g., West Nile Virus, Eastern Equine Encephalitis, Lyme Disease, anaplasmosis, influenza). One year contract for Lead Veterinarian Detection and Epidemiology.
2012	Released a proposal for disease reporting requirements under Animal Health Act for public comment (including requiring laboratory reporting of diseases affected by climate change) during spring 2012. Lead Veterinarian Detection and Epidemiology established as a permanent position. Implemented a new data system to track reports of changes in domestic animal diseases including those affected by climate change. Continued participation and contribution to national animal disease surveillance.
2013	Implementation of disease reporting regulations including diseases affected by climate change. Continuing research funding under OMAFRA/University of Guelph partnership agreement for research in animal disease detection and response including diseases affected by climate change. Continuing participation and contribution to national animal disease surveillance.
2014 and beyond	Continuing participation and contribution to national animal disease surveillance.

#13 PROTECT PLANT HEALTH

Lead Ministry: OMAFRA

2011	Continued involvement in trials to evaluate field and horticultural crop varieties for resistance to pest/diseases. Funded research on adapting agricultural production systems to invasive pest species. Partner in the North American Soybean Rust Sentinel Plot Network – an early warning system for this fungal disease and other soybean diseases and pests such as aphids, viruses, Soybean Cyst Nematode. Monitored the presence of Spotted Wing Drosophila and Brown Marmorated Stink Bug. Ongoing development of mitigation strategies and outreach programs. Continued collaboration with industry, academia and other government agencies to monitor noxious weeds and support development of management strategies. OMAFRA and its Environmental Farm Plan (EFP) delivery partners promoted the adoption of best management practices that build resilience to climate change (see also Action 27).
2012	Ongoing trials to evaluate field and horticultural crop varieties for resistance to pest/diseases. Ongoing research to adapt agricultural production systems to invasive pest species such as the biology and control aspects of Drosophila. Continued support for monitoring and surveillance activities of plant diseases and insects of economic relevance to Ontario's agricultural sector (e.g., sentinel plots for soy bean rust, surveillance survey for Brown Marmorated Stink Bug, Spotted Wing Drosophila and Western Bean Cutworm). Ongoing collaboration with industry, academia and other government agencies to monitor noxious weeds and support development of management strategies. Ongoing collaboration with EFP delivery partners to promote the adoption of best management practices that build resilience to climate change into the plant agriculture sector.
2013	Ongoing trials to evaluate field crop varieties (including biomass crops) and horticultural crop varieties for many attributes including resistance to pest/diseases. Ongoing research related to adapting agricultural production systems to invasive pest species. Continuing support to monitoring and surveillance activities for plant diseases and insects of economic relevance to Ontario's agricultural sector. Ongoing collaboration with industry, academia and other government agencies to monitor noxious weeds and support development of management strategies. Ongoing collaboration with EFP delivery partners to promote the adoption of best management practices that build resilience to climate change in the plant agriculture sector.
2014 and beyond	Ongoing trials to evaluate field crop varieties (including biomass crops) and horticultural crop varieties for many attributes including resistance to pest/diseases. Ongoing research related to adapting agricultural production systems to invasive pest species. Continuing support to monitoring and surveillance activities for plant diseases and insects of economic relevance to Ontario's agricultural sector. Ongoing collaboration with industry, academia and other government agencies to monitor noxious weeds and support development of management strategies. Ongoing collaboration with EFP delivery partners to promote the adoption of best management practices that build resilience to climate change in the plant agriculture sector.

#14 ENCOURAGE BUSINESS RISK-MANAGEMENT APPROACHES

Lead Ministry: OMAFRA

2011	Continued engagement in Federal/Provincial/Territorial (F/P/T) discussions leading to the next five-year national agriculture policy framework 2013-18; Growing Forward 2. OMAFRA updated the research priorities of the seven research themes under the partnership agreement with University of Guelph including links to climate change adaptation and mitigation. Ongoing OMAFRA funded research included identifying risks and opportunities associated with climate change and helped Ontario's agriculture sector adapt to these anticipated changes including production diversification opportunities. Continued knowledge sharing and transfer between OMAFRA and MOE on climate modelling and weather-related agricultural business risks.
2012	Anticipated conclusion of F/P/T negotiations on Growing Forward 2 which would include business risk management programs. Explored new business risk management models that include consideration of future changes in weather and climate. Ongoing multi-year research linked to climate change was funded under OMAFRA's partnership agreement with the University of Guelph.
2013	Anticipating implementation roll-out of the Growing Forward 2 policy framework. Ongoing multi-year research linked to climate change funded under OMAFRA's partnership agreement with the University of Guelph.
2014 and beyond	Ongoing implementation of the Growing Forward 2 policy framework. Ongoing multi-year research linked to climate change funded under OMAFRA's partnership agreement with the University of Guelph.

#15 PILOT ADAPTATION STRATEGIES IN THE TOURISM SECTOR

Lead Ministry: Ministry of Tourism (MTCS)

2011	Ministry of Tourism, Culture and Sport explored opportunities to address and raise awareness of climate change impacts with the tourism industry.
2012	On-going.
2013	On-going.
2014 and beyond	On-going.

#16 CONSERVE BIODIVERSITY AND SUPPORT RESILIENT ECOSYSTEMS

Lead Ministry: MNR

2011	50 Million Tree Program in progress and continuing to 2020 to achieve objectives. Released A Practitioners Guide to Climate Change in Ontario's Ecosystems in November 2011. Each year, MNR will work with other Ontario ministries to develop priorities for the next 12 months, and will identify and describe them in an annual implementation plan. Continuing work on vulnerability assessments over coming 5 years, building new publicly accessible tools and information. Outreach and collaborations will be pursued. Ongoing research into the potential for assisted migration as an adaptation tool for species that cannot move fast enough to escape the effects of a rapidly changing climate.
2012	Government response to Biodiversity Strategy to be finalized. Actions support through to 2020. The Invasive Species Strategic Plan will be used to assist in setting priorities for action by the lead Ministries. Assisted Migration: Three plantation trials have been established to date. Northeast Ontario Clay Belt Vulnerability Assessment completed.
2013	
2014 and beyond	

#17 UNDERTAKE FOREST ADAPTATION ASSESSMENT

Lead Ministry: MNR

2011	Assisted migration papers developed by CCFM were featured in a special edition of Forestry Chronicle in December 2011. A set of case studies from jurisdictions across the country will document vulnerability assessments that have occurred and are occurring in Canada.
2012	Three e-learning modules rolled out in June 2012 to forest management planning teams. Modules focused on the effects of climate change on Ontario's forests and climate change policy. Released a suite of forestry-focused adaptation tools by CCFM. Continued research to understand potential impacts of climate change and extreme weather events on our forests.
2013	Continuing research to understand potential impacts of climate change on growth and yield, species composition, invasive pest infestations and extreme weather events on our forests. Continuing research to understand the impacts of climate change on carbon storage and releases in the vast peat lands of Ontario's Far North and carbon cycling in our forests.
2014 and beyond	Continuing research to understand potential impacts of climate change and extreme weather events on our forests.

#18 BUILD ADAPTATION INTO GREAT LAKES AGREEMENTS

Lead Ministry: MOE

2011	Build adaptation into Great Lakes agreements.
2012	Negotiated a new Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA), which includes commitments to climate change adaptation. New COA drafted; posted to the Environmental Registry for public comment.
2013	Anticipating new COA signed; implementation begins.
2014 and beyond	Ongoing implementation of new COA commitments.

#19 EXAMINE CLIMATE CHANGE IMPACTS ON FISHERIES

Lead Ministry: MNR

2011	MNR Climate Change Research Reports made available online include: • Regional Projections of Climate Change Effects on Ontario Lake Trout Populations. • Key Ecological Temperature Metrics for Canadian Freshwater Fishes. • A Summary of the Effects of Climate Change on Ontario's Aquatic Ecosystems.
2012	Continued science and research to examine changing climate conditions on fish populations, fitness, spawning, invasive species and food webs.
2013	Interactive web-based mapping tools to be completed to explore fish sensitivity to climate change.
2014 and beyond	

#20 DEVELOP THE LAKE SIMCOE ADAPTATION STRATEGY

Lead Ministry: MOE

2011	Developed draft Lake Simcoe Adaptation Strategy.
2012	Lake Simcoe Climate Change Adaptation Strategy is currently undergoing internal review and approval. We anticipate the strategy will be posted as a policy proposal on the Environmental Registry for a review and comment period.
2013	
2014 and beyond	

#21 INCREASE AWARENESS OF LAND USE PLANNING TOOLS

(Climate change and sustainable land use planning considerations and practices are being incorporated into education and training outreach products and activities to the municipal sector.)

Lead Ministry: MMAH

2011	Webinar for municipal sector.
2012	Completion date for webinar to be determined – target of Fall 2012.
2013	
2014 and beyond	

#22 INTEGRATE ADAPTATION POLICIES INTO THE PROVINCIAL POLICY STATEMENT

Lead Ministry: MMAH

2011	Provincial Policy Statement Review underway.
2012	PPS Review ongoing; analysis and consideration of the need for revisions, including climate change policy.
2013	Anticipated completion of revised PPS, subject to government approvals and timing considerations; • Implementation of revised PPS.
2014 and beyond	Continuing implementation of revised PPS.

#23 CONSIDER CLIMATE CHANGE IN THE GROWTH PLAN FOR NORTHERN ONTARIO

Lead Ministry: MNDM

2011	Worked with all communities, all orders of government, and all sectors of Northern Ontario to implement the Growth Plan for Northern Ontario, a 25-year strategic framework to guide provincial investment and policy decisions in Northern Ontario. The environment chapter includes policies recognizing the need for climate change mitigation and adaptation, which are of particular importance in Northern Ontario.
2012	Climate change mitigation and adaptation considered as initiatives were developed that advance policies identified in the Growth Plan for Northern Ontario. Implementation on-going.
2013	Climate change mitigation and adaptation will be considered as initiatives are developed that advance policies identified in the Growth Plan for Northern Ontario. Implementation on-going.
2014 and beyond	Climate change mitigation and adaptation will be considered as initiatives are developed that advance policies identified in the Growth Plan for Northern Ontario. Implementation on-going.

#24 RAISE AWARENESS ABOUT HEALTH HAZARDS OF CLIMATE CHANGE

Lead Ministry: Ministry of Health and Long-Term Care (MOHLTC)

2011	Monitored public health impacts of climate change.
2012	Ongoing identification of common linkages and best management practices (BMPs) for protecting human health from the negative effects of climate change. Ongoing consultations with Public Health Units and other partners regarding the development of a local adaptation framework focusing on linkages between human health and the environment.
2013	Completion date to be determined.
2014 and beyond	

#25 RAISE PUBLIC AWARENESS OF LYME DISEASE

Lead Ministry: MOHLTC

2011	2011 Lyme disease strategy included continued human and tick surveillance, tick control and public education.
2012	Ongoing human and tick surveillance, tick control and public education.
2013	
2014 and beyond	

#26 UPDATE INTENSITY-DURATION-FREQUENCY (IDF) CURVES

Lead Ministry: Ministry of Transportation (MTO)

2011	Developed the first phase of the update of the IDF curves tool for use in the design of highway drainage infrastructure. Monitored technical activity to stay informed of emerging and developing thinking as well as strategic societal directions.
2012	Updated the IDF curves to include the latest available data. Used IDF curves in the assessment of resilience of the highway drainage infrastructure. Continued monitoring technical activities related to climate change modelling and climate data.
2013	Continuing improvement of the IDF curve to incorporate changes in science and technology.
2014 and beyond	Updating the rainfall data used in the IDF curves as they become available from Environment Canada. Incorporating rainfall data from MTO Road Weather Information Systems (RWIS) station into the IDF curves updates to enhance data from areas in Ontario where data gaps have been identified.

#27 UPDATE THE ENVIRONMENTAL FARM PLAN PROGRAM

Lead Ministry: OMAFRA

2011	Continued development of 4th edition of Environmental Farm Plan (EFP) workbook including revision of 23 worksheets (e.g. water use efficiency, energy efficiency, nutrient use efficiency, soil conservation). Published new Best Management Practice (BMP) handbook Controlling Soil Erosion on the Farm. Ongoing improvement of recommended BMPs through projects in the field funded under the Best Management Practices Verification and Demonstration Program. Among projects undertaken that have climate change adaptation elements are those related to treatment and recycling of food processor, greenhouse and vegetable wash water, life cycle models of biomass for energy generation, water use efficiency in dairy milkhouses, soil health and species-at-risk habitat management.
2012	EFP workbook: 4th edition tracking for fall 2012 release. Ongoing development of new titles and released new BMP handbook: On Farm Energy: A Primer. Ongoing improvement of recommended BMPs through projects in the field funded under the Best Management Practices Verification and Demonstration Program. Discussions with Canada and Ontario Farm Environmental Coalition on design options for the Canada-Ontario Farm Stewardship Program (COFSP), the cost-share program under Growing Forward 2 (2013-18) aimed at on-farm improvements identified in EFPs.
2013	Future funding for COFSP as well as program details subject to outcome of Growing Forward 2 discussions. Ongoing development and improvement of BMP publications and recommended BMPs through projects in the field funded under the Best Management Practices Verification and Demonstration Program.
2014 and beyond	On-going.

#28 PROVIDE COMMUNITY OUTREACH AND TRAINING

Lead Ministry: MOE, MNR

2011	Ontario Centre for Climate Impacts and Adaptation Resources, in partnership with Clean Air Partnership, received funding from MOE through a Transfer Payment agreement, the Community Adaptation Initiative, at a value of $460,000 over two years (2010-2012).
2012	Final year of funding Community Adaptation Initiative. Adaptation tools and information developed over the last two years were made available at www.climateontario.ca.
2013	Continuing to provide outreach and training to practitioners through presentations and conferences.
2014 and beyond	

#29 DEVELOP THE FAR NORTH LAND USE STRATEGY

Lead Ministry: MNR

2011	Five communities completed land use plans with Ontario – Pikangikum, Cat Lake, Slate Falls, Pauingassi and Little Grand Rapids. The joint Cat Lake-Slate Falls Community Based Land Use Plan recognized the need to understand and adapt to climate change. These plans were jointly approved by the respective First Nations and the Minister of Natural Resources under the Far North Act, 2010.
2012	27 other Far North communities began the initial steps in community based land use planning, e.g., community meetings, mapping their Aboriginal Traditional Knowledge, working with MNR on preparing terms of reference for planning.
2013	
2014 and beyond	

#30 INCORPORATE CLIMATE CHANGE INTO CURRICULUM

Lead Ministry: Ministry of Education (EDU)

2011	Revised elementary and secondary curriculum policy documents using the Standards for Environmental Education in the Curriculum to ensure increased focus on environmental issues such as climate change and its impacts. An emphasis on critical thinking, problem solving, collaboration and other skills will help students address environmental issues as knowledge expands. In addition to the curriculum policy documents, learning resources which support environmental education were made available to all of Ontario's 5,000 English and French-language schools.
2012	On-going.
2013	On-going.
2014 and beyond	On-going.

#31 ENHANCE CLIMATE-RELATED MONITORING

Lead Ministry: MOE, MNR

2011	
2012	Completed water monitoring site installation in the Spring of 2012. Through COA, funding was provided to assess Lake Superior watersheds for integrated monitoring. Additionally, MNR enhanced water monitoring in the Far North. A review of land use criteria and priority ranking for stream gauges was completed and 10 stream gauges were installed. MOE continued monitoring efforts in the Far North (e.g., carbon flux monitoring) and under the Ontario Forest Biomonitoring Network.
2013	Collecting and sharing of data with stakeholders and general public. Pursuing collaborative opportunities for all monitoring networks. Development of integrated data analyses. Pursuing opportunities for network enhancement with focus on the Far North. MNR will share recommendations for enhancements to climate change monitoring where necessary. MOE will continue monitoring efforts in the Far North (e.g., carbon flux monitoring) and under the Ontario Forest Biomonitoring Network.
2014 and beyond	Collection of data, sharing data with stakeholders/general public. Continue monitoring efforts in the Far North and under the Ontario Forest Biomonitoring Network. Development of integrated data analyses. Pursuing opportunities for network enhancement with focus on the Far North.

#32 UNDERTAKE CLIMATE IMPACT INDICATORS STUDY

Lead Ministry: MOE, MNR

2011	Established a multi-ministry staff level working group. Reviewed various international indicator studies including ecosystems, economy and weather events data. MNR and MOE analysed potential use of data from existing monitoring programs and developed a short-list of Ontario climate indicators to track.
2012	Created baseline indicators using trends data already collected.
2013	Results of climate indicators including economic/ecological data will be included in annual report.
2014 and beyond	New indicators will be added as appropriate as data becomes available, including agriculture, tourism and infrastructure.

#33 UNDERTAKE RESEARCH PARTNERSHIPS FOR CLIMATE MODELLING

Lead Ministry: MOE

2011	Invested over $1M from 2008-2011 for regional climate modelling with partners. Outcomes include: • OURANOS: Modelling distribution of trends of major climate indicators across Ontario (45km x 45km grids) using a Canadian model (CRCM). • University of Regina: Modelling distribution of trends of major climate indicators across Ontario (25km x 25km grids) using the UK Providing Regional Climate for Impact Studies (PRECIS) model. • University of Toronto/SciNet: Modelling Ontario's climate change at high-resolution (10km x 10km grids) with US Weather Research and Forecasting (WRF) model on the SciNet Supercomputer System. • University of Regina: Modelling Ontario's climate change at high resolution (25km x 25km grids) with UK PRECIS Model and further downscaling to 10km x 10km resolution. • University of Toronto-Scarborough: Developing future climate change projections over Ontario at annual, seasonal and monthly scales using statistics. • York University: Assessing potential changes in extreme winds over Ontario using high resolution data from observations and models. • York University: Developing high-resolution (45km x 45km grids) probabilistic climate projections for mean conditions over Ontario from multiple regional and global climate models. • University of Regina: Developing high-resolution (25km x 25km grids) probabilistic climate projections for mean conditions over Ontario from large ensemble runs of the UK PRECIS model. • University of Toronto/SciNet: Improving regional climate modelling over Ontario at high-resolution (10km x 10km grids) with US Weather Research and Forecasting (WRF) model coupled with HydroGeosphere on the SciNet Supercomputer System.
2012	Piloted the development of a climate data portal with a user friendly graphical interface for less technical users and data download capability for more technical users. Continued to advance Ontario focused climate data in consultation with climate adaptation practitioners. Continued to foster partnerships with internal and external partners.
2013	Updating and maintaining climate data portal. Continue advancing Ontario focused climate data, including consideration of Intergovernmental Panel on Climate Change's Fifth Assessment Report (AR5), in consultation with climate adaptation practitioners. Continue fostering partnerships with internal and external partners and supporting the development of applications of climate data e.g., case studies.
2014 and beyond	Updating and maintaining climate data portal. Continuing to advance Ontario focused climate data in consultation with climate adaptation practitioners. Continuing to foster partnerships with internal and external partners and supporting the development of applications of climate data e.g., case studies.

#34 ESTABLISH AN OPS CLIMATE MODELLING COLLABORATIVE

Lead Ministry: MOE

2011	Established an OPS Climate Modelling Collaborative made up of senior representatives from 10 ministries and five agencies.
2012	Established Strategic Assistant Deputy Ministers Steering Committee established to consider path forward. Quarterly meetings of the OPS Climate Modelling Collaborative were held to identify gaps and synergies.
2013	Reviewing effectiveness of the Collaborative in mainstreaming climate modelling into ministry decisions and long-term plans.
2014 and beyond	

#35 ESTABLISH AND LEAD ONTARIO'S REGIONAL ADAPTATION COLLABORATIVE (RAC)
PARTICIPATE IN NRCAN ADAPTATION PLATFORM AND WORKING GROUPS

Lead Ministry: MOE, MNR, MMAH

2011	Ontario RAC is established - seven projects led by three ministries and seven external partners were successfully rolled out across Ontario.
2012	Ontario RAC projects were completed by June 2012; Ontario Communities were provided ongoing access to new adaptation tools, case studies, training and climate science information. Began participating in Natural Resources Canada's new Adaptation Platform program and plenary working groups.
2013	Adaptation Platform to bring together national industry associations, national professional organizations, representatives from federal, provincial and territorial governments, as well as other relevant organizations to address shared adaptation priorities. Key sectors to be addressed in 2012-2013 include mining and metals, forests, coastal management, economic analysis and measuring progress on adaptation.
2014 and beyond	Adaptation Platform Regional Adaptation Collaborative (RAC 2) ongoing from 2012-2016.

#36 WORK WITH THE CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT AND CANADIAN COUNCIL OF FOREST MINISTERS

Lead Ministry: MOE, MNR

2011	Completed and released a series of papers in a special edition of the Forestry Chronicle journal in December 2011 focusing on assisted migration. Complementary outreach with forestry practitioners in fall 2011 and winter 2012.
2012	Finalized and released the document Tools for Climate Change Vulnerability Assessment for Watersheds. Developed RFP for next phase; Implementation Framework for Climate Change Adaptation. Selection of contractor, continuing as project authority. Released of CCFM forestry-focused adaptation tools and resources.
2013	Development of tools for climate change monitoring of the cryosphere, i.e. monitoring of permafrost, sea ice, glaciers, and other factors important to the North.
2014 and beyond	

#37 PARTICIPATE IN THE TERRITORIAL APPROACH TO CLIMATE CHANGE (UNITED NATIONS DEVELOPMENT PROGRAMME)

Lead Ministry: MOE

2011	Ontario – UNDP Contribution Agreement negotiated. Project document developed by UNDP with input from Peruvian partners and Ontario.
2012	Ontario – UNDP Contribution Agreement finalized. Project Document finalized by the UNDP and Peruvian partners and Ontario started to flow funding to the UNDP in three instalments.
2013	Preparation of the Regional Climate Profile and identification of early 'no regrets' actions.
2014 and beyond	Integrated Territorial Climate Change Plan developed, including identification of priority mitigation and adaptation needs.

ADDITIONAL INITIATIVES

ONTARIO PUBLIC SERVICE GREEN TRANSFORMATION STRATEGY

Lead Ministry: Ministry of Government Services (MGS)

2011	Continued to reduce Ontario Public Service carbon footprint focusing on energy conservation through reduced consumption in travel and fuel use, print devices and paper, e-business transformation and other areas. All ministries implemented multi-year green plans to embed greening into their business practices.
2012	Continued to reduce energy consumption, adopt clean energy solutions, implement innovative business processes and empower staff.
2013	Expanding engagement with the broader public service and other partners to create a greener public sector.
2014 and beyond	Continuing to reduce Ontario public service carbon footprint by increasing environmental and fiscal efficiency.

DAM SAFETY GUIDANCE

Lead Ministry: MNR

2011	Updated Ontario dam safety standards by releasing updated technical guidelines and best management practices through a policy decision notice on the Environmental Registry in August 2011.
2012	The Administrative Guide for the Lakes and Rivers Improvement Act, technical bulletins and best management practices will ensure safe design, construction and operation of dams. There are currently six technical bulletins and two best management practices.
2013	
2014 and beyond	

Technical Appendix C

Assurance Statement

Attachment A: Assurance Statement

Based on the methods, data sources, and assumptions used to forecast Provincial GHG emissions for the Ontario Climate Change Action Plan 2010-11 Annual Report, the forecasted business as usual emissions for Ontario are a fair representation of those expected using current best practices in GHG emissions forecasting. Further, based on those methods, data sources and assumption used to model GHG reductions for the fifteen initiatives in the 2011 Annual Report, the estimated future annual GHG emissions reductions are a fair representation of forecasted annual GHG emissions reductions that would be expected using current best practises in the evaluation of GHG mitigation programs.

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