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Greenhouse Gas Mitigation in Canada

CanCompete

ENERGY, ENVIRONMENT AND TRANSPORTATION POLICY

Greenhouse Gas Mitigation in Canada
by *Len Coad*

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Preface

Canada's efforts to reduce greenhouse gas emissions have amounted to a patchwork of federal programs and regulations and separate provincial action plans. Through a review of federal, provincial, and territorial climate change action plans, this report reveals how the approach to reducing emissions has been neither effective nor cost-efficient. This report also suggests how a coordinated approach—to carbon pricing, for example—could reduce emissions more efficiently.

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EXECUTIVE SUMMARY

Greenhouse Gas Mitigation in Canada

At a Glance

- Lack of coordination between governments in Canada has hindered both the effectiveness of efforts to reduce GHG emissions and their efficiency (the cost per unit of reductions).
- Although provincial climate change action plans generally align well with the need to reduce emissions in particular sectors, it is difficult to measure the progress achieved.
- The national target of a 17 per cent reduction in emissions by 2020 and the individual provincial targets are being addressed through a complex, diverse, and opaque mix of instruments and programs.
- Carbon pricing is one area where a coordinated approach may produce more efficient results.

Canada's efforts to reduce greenhouse gas (GHG) emissions have not been coordinated. Each province has developed and implemented its own climate change action plan, and the federal government has created programs and regulations to reduce emissions. With this patchwork of initiatives and priorities, it is reasonable to ask whether the combined regulatory approach is effective, whether it is efficient, and what burden is being imposed on regulated entities. This report focuses primarily on the first two issues.

Canada's GHG emissions increased by 142 million tonnes between 1990 and 2008. Stationary energy accounted for 54 million tonnes of the growth, and transportation emissions grew by 53 million tonnes. Although emissions stabilized between 2004 and 2008, we have not yet seen the strong downward trend that will be required to help mitigate global warming.

Canada's GHG emissions increased by 142 million tonnes between 1990 and 2008, and we have not yet seen the strong downward trend that will be required to help mitigate global warming.

Each province faces its own challenges in reducing emissions. These challenges relate largely to the way energy is produced and used. Alberta, as the largest energy producer in Canada, also has the largest GHG emissions. Ontario ranks second, primarily because of energy consumption. Quebec is third, again because of energy consumption. It stands to reason that each province has created a climate action plan that responds to its key priorities.

All provinces have developed climate action plans and set emissions reduction targets and timing. For most provinces, the climate action plans link to energy strategies. Increasing dependence on renewable energy, energy conservation programs, energy efficiency programs, and public communication are among the tools being used in most provinces. Climate action programs often include

such measures as capital subsidies, technology development funding, technology implementation funding, building retrofits, new building efficiency standards, public transit efficiency investments, encouraging people to use public transit, greening government operations, etc.

The national objective to reduce GHG emissions by 17 per cent by 2020 would still leave emissions 10 per cent above the 1990 level; there is a clear need to accelerate reductions to meet the 2020 targets.

There is no certain measure of the effectiveness of the climate action plans, given that they are forward looking and that there is a substantial gap between historical emissions performance and future targets. In fact, all provinces except Quebec have experienced an increase in GHG emissions since 1990, and the reduction in Quebec has been very modest. On the other hand, all provinces have targeted significant emissions reductions by 2020. Although the recent trend has been a levelling off in emissions in connection with voluntary actions and implementation of the provincial climate action plans, there is a clear need to accelerate reductions to meet the 2020 targets.

The national objective to reduce GHG emissions by 17 per cent by 2020 (relative to a 2005 baseline) would still leave emissions 10 per cent above the 1990 level. One of the key elements of regulatory effectiveness is to measure and track the impacts of individual actions. But the intended impact of individual items and initiatives within each provincial action plan is most often unstated. This makes it challenging to quantify how much of the gap between current emissions and reduction targets will be met.

Measurement and performance tracking is key to the effectiveness of any government program or initiative. The provincial climate action plans take diverse approaches to this. Quebec, for example, has a detailed action plan with many action items. However, the expected GHG savings from specific action items are not often detailed. This makes it difficult to track progress toward success on individual items. Alberta, on the other hand, has specific overall reduction targets for broad categories such as conservation, technology, and carbon capture and storage. But the detailed action items and their contribution to the targets are less clearly articulated. All provinces identify the near-term spending for their action plans, although the longer-term investments are not completely described.

Given the partially articulated goals, the lack of specificity about the reductions to be achieved by individual actions, and the uncertainty about long-term spending commitments, the effectiveness of climate action plans cannot be assessed with any certainty.

A broad range of tools is being used to reduce emissions. They include voluntary markets for carbon reduction, regulatory limits on emissions intensity, proscriptive regulations (tailpipe emissions and electricity generation emissions, for example), communication programs, investment programs, capital subsidies, and government initiatives to green their own operations. Carbon pricing in the form of cap and trade mechanisms or a carbon tax has not been broadly implemented. Although it is unrealistic to expect that a single tool can be applied to all sources of emissions, the efficiency of GHG reduction policies, regulations, and programs could be significantly improved through better coordination and broader, more consistent application.

Carbon pricing in the form of cap and trade mechanisms or a carbon tax has not been broadly implemented.

Carbon pricing provides a clear example. British Columbia and Quebec have implemented carbon taxes, which place a price on GHG emissions through a tax on fuels or utility services. The resulting revenue in B.C. is returned to taxpayers. In Quebec, it funds climate action and green energy initiatives. Alberta does not have a carbon tax, but it does have intensity caps on large final emitters, with the regulations including options to buy offsets within the province or pay a penalty into a technology fund. The offsets option provides a pricing mechanism for carbon, but within a very small intra-provincial market with little liquidity. The penalty option generates funds that are reinvested in technology development and implementation projects to reduce carbon emissions. In addition,

several Canadian provinces have cap and trade regulations on the books, ready for implementation, but not yet implemented. The stumbling block appears to be progress on implementing cap and trade regionally, or even on a North American basis. A coordinated and broad initiative on carbon pricing could contribute to efficiency by providing a single market with a single set of requirements for participation, as well as a greater volume of trading to improve liquidity and establish a price for carbon that reflects a larger market.

Better coordination and communication of the policy priorities, emissions impacts, and interactions between climate action items would help Canadians understand the process and would make it possible to measure progress. Rather than examining each measure on its own, the interactions and cumulative impacts of all measures should be analyzed and communicated to stakeholders.

CHAPTER 1

Introduction

Chapter Summary

- Canada's governments have each chosen their own path to GHG emissions reductions.
- This report provides a qualitative assessment of the effectiveness and efficiency of provincial climate change action plans and of selected federal programs.
- Comparing sectoral emissions profiles in each province against action plan priorities provides a basic gap analysis.

Greenhouse gas (GHG) emissions in Canada are among the highest in the world on a per capita basis, although Canada contributes only about 2 per cent of total global emissions. The past 20 years have seen numerous analyses of the emissions sources and appropriate actions to reduce GHG emissions. Policies and regulations have been proposed and, in many cases, implemented. However, there has not been a consensus in Canada on the best approaches. Federal and provincial governments have taken their separate paths, with only limited coordination. This report focuses on those paths and the progress being made toward emissions reductions.

As a signatory to the Kyoto Accord, Canada has made commitments to reduce emissions; the country also renewed its position through the Copenhagen discussions in late 2009. However, the extent to which commitments have been supported by action is questionable, particularly given that Canada's total emissions in 2008 remained more than 25 per cent above 1990 levels.

Federal and provincial governments have taken their separate paths, with only limited coordination.

The path from commitments to reductions is a difficult one for Canada for many reasons. More than 82 per cent of emissions come from the production, transportation, transformation, and use of energy. Canada's energy resources, both renewable and non-renewable, are unevenly distributed across the country, and ownership and control over their development rests primarily with provincial and territorial governments. These governments have taken different policy and development paths, partly because each provincial and territorial economy is structured differently. Alberta, British Columbia, Saskatchewan, and Newfoundland and Labrador receive significant government revenues from and employ thousands of Canadians in extracting and processing non-renewable energy. Quebec, British Columbia, Manitoba, and Yukon use renewable hydroelectricity as their main source of electricity. Environmental protection is also an area of provincial, federal, and shared jurisdiction. The end result is that regulations intended to reduce GHG emissions in Canada involve federal, provincial, and territorial governments, with each government bringing its own perspective to the task.

For a range of reasons that are documented elsewhere, Canada's governments have chosen their own paths to GHG emissions reductions. All provinces and territories have climate change action plans. Each action plan has been developed within the past decade, and most have been regularly updated. The federal government has taken action as well. What has been lacking is an integrated or even a coordinated federal-provincial approach.

This research project examines the patchwork of federal, provincial, and territorial initiatives fairly narrowly from a regulatory point of view. Information about the action plans and progress to date was gathered and examined to address three questions:

- Is the initiative effective in achieving its desired result?
- Is the initiative economically efficient?
- What regulatory burden is imposed?

The climate change action plans in place in Canada combine elements of regulation, incentive payments (subsidies), program funding, and investments.

These questions are often applied to examine regulatory programs. However, the climate change action plans in place in Canada combine elements of regulation, incentive payments (subsidies), program funding, and investments. This report considers the range of action plan initiatives, without limiting the discussion to the regulatory components. The three questions can be answered both qualitatively and quantitatively, although the quantitative data are often hard to gather. Effectiveness refers simply to whether or not there is a performance target, whether metrics are identified, and whether the initiative contributes to meeting the target. Individual initiatives may make large or small contributions to meeting the target, but it is important to have some measure of success in mind to be able to determine whether the target has been achieved. Economic efficiency hinges on whether a particular initiative achieves its target using minimal resources. This can be measured by the direct cost of the initiative and by the impact it has on economic performance overall. The regulatory burden is most often measured as the direct and indirect effects that an initiative has on those whose behaviour must comply with the regulation.

Most of the research for this project is qualitative in nature. The work began, however, with an analysis of GHG emissions by sector and by province, relying on the data from Environment Canada's latest *National Inventory Report* (NIR), for 1990–2008. The NIR presents an inventory of GHG emissions, compiled annually as part of Canada's obligation to the United Nations Framework Convention on Climate Change (UNFCCC). This analysis provides a picture of the trend-line progress to date for each sector and province, and helps to identify where further action is required to reduce emissions.

Given that each province and territory has a climate action plan, and that those plans are public, a great deal of analysis can be based on those plans and their associated updates, programs, and investments. To a certain extent, it is also possible to "follow the money" and compare the action items, funding, and emissions by sector. This permits at least a qualitative assessment of the progress to date, as well as of the gap that remains to be closed. It is difficult, if not impossible, to fully assess the effectiveness of the action plans since many of their action items do not include specific targets or even anticipated reductions in GHG emissions. Similarly, given the gaps in funding information for each action item, it is difficult to properly assess the economic efficiency of the action plans, although qualitative observations can be made.

This report begins by profiling Canada's GHG emissions, first by sector and then geographically. Trends are presented, although caution must be exercised in interpreting the time-series data. Most of the emissions data are estimated based on economic output and energy consumption, resulting in emissions factors. On a regular basis, key sectors (in terms of their GHG emissions or the uncertainty surrounding emissions factors, etc.) are re-examined. These evaluations can result in new emissions factors, new emissions estimates, or both. As a result, what sometimes appears as a shift in performance can be explained more properly as a change in estimation methodology.

NIR data are presented in categories that are different from the North American Industry Classification System (NAICS), although Statistics Canada does use NIR data to estimate emissions by economic sector based on NAICS codes. The highest-level categories in the NIR

are energy, industrial processes, solvents, agriculture, and waste—categories that do not correspond directly with gross domestic product (GDP) data. As a result, emissions data do not correspond directly with GDP data either. For example, emissions resulting from energy consumption in the agricultural sector are reported in the NIR as energy-related emissions, rather than agricultural. Agricultural emissions are from enteric fermentation (animal digestion), manure management, and soil management. Within the energy sector, there are subdivisions for stationary energy production and consumption, transportation, and fugitive emissions (unintended escape of hydrocarbons, natural gas processing emissions, etc.).

Our comparison shows whether the action plans are targeting the most important emissions sources, and indicates how much progress is being made as compared with expected future progress.

A comparison of the NIR emissions data with the provincial and federal action plans provides a basic gap analysis. At a qualitative level, the comparison shows whether the action plans are targeting the most important emissions sources, and indicates how much progress is being made as compared with expected future progress. Second, it provides a basis for quantitative analysis of the effectiveness and efficiency of current action plans, to the extent that data can be found. Third, the gap analysis permits recommendations for further action.

In addition to qualitative and quantitative analysis, the research for this project included a one-day workshop. Representatives of several key sectors were invited to present their views and provide comments on the effectiveness, efficiency, and burden questions. The workshop was held in late May 2010. Representatives from automobile manufacturing, renewable fuels producers, hydrocarbons producers, building design, agriculture, alternative energy, and road network design and operations presented their views and identified additional research questions.

Chapter 2 of the report profiles the major sources of GHG emissions by economic sector, or category, as defined in the UNFCCC reporting structure. It also describes the regional sources of emissions within each category. Chapter 3 reviews the climate change action plans of the provinces and territories, again sorted by emissions categories. It provides an overview of the areas of focus in the action plans. Some of the more significant federal initiatives are also described. Chapter 4 provides a qualitative analysis of the progress made to date and the gap that remains to be closed. Chapter 5 revisits the concepts of effectiveness, efficiency, and burden and draws some qualitative conclusions.

CHAPTER 2

The Nature of the Challenge—Profiles by Sector and Region

Chapter Summary

- Together, transportation and the stationary production or use of energy account for 90 per cent of the growth in GHG emissions in Canada since 1990.
- Although Canada's total GHG emissions have increased since 1990, the intensity has declined. This suggests that intensity-based solutions must be carefully designed if they are to achieve overall reductions.
- Stationary energy emissions are largest in Alberta, Ontario, and Saskatchewan.
- Transportation emissions continue to rise because of the growing number of vehicles on the road and the increasing share of vans, SUVs, and trucks. Both of these factors have a stronger influence on emissions than improvements in vehicle efficiencies.

Canada's GHG emissions increased steadily from 1990 to 2004, and then moved up and down within a fairly narrow range through 2008. (See Chart 1.) Given Canada's steady population growth over the same period, per capita emissions show a similar trend. (See Chart 2.) Two categories explain most of the 142 million tonnes increase in emissions between 1990 and 2008: stationary energy (increased by 54 million tonnes) and transportation (increased by 53 million tonnes). If fugitive emissions (increased by 21 million tonnes) are included with stationary energy, almost all of the growth is accounted for. Indeed, it is appropriate to include fugitive emissions with stationary energy since almost all fugitive emissions in Canada result from hydrocarbons production and processing.

The growth in stationary emissions and transportation emissions has been about equal in volume.

Charts 1 and 2 combined present several messages. Canadian GHG emissions have increased significantly since 1990, although almost all of the increase occurred prior to 2005. This is important to note, since most provincial climate change action plans include measures that have been implemented since 2004. In addition, the growth in stationary emissions and transportation emissions has been about equal in volume, even though stationary energy started from a much higher level. Stationary energy includes electricity production, fossil fuels exploration and production, mining, energy consumed by manufacturing, construction, agricultural energy use, commercial buildings, and residential buildings. Transportation includes all energy used in air travel (Canadian destinations only), passenger vehicles (whether private or commercial), railways, marine transport, and road freight transport. Stationary energy and transportation account for the majority of GHG emissions in Canada and almost all of the growth over the past two decades. Emissions related

to energy combustion for transportation have increased at a compound annual rate of 1.7 per cent, and emissions from the stationary energy category have grown at a compound annual rate of 1 per cent. Canada's population has grown by 1 per cent per year, suggesting that the emissions intensity of the transportation sector has grown steadily, whereas the emissions intensity of stationary energy has remained constant overall. Both sectors reveal underlying trends once the data are decomposed further.

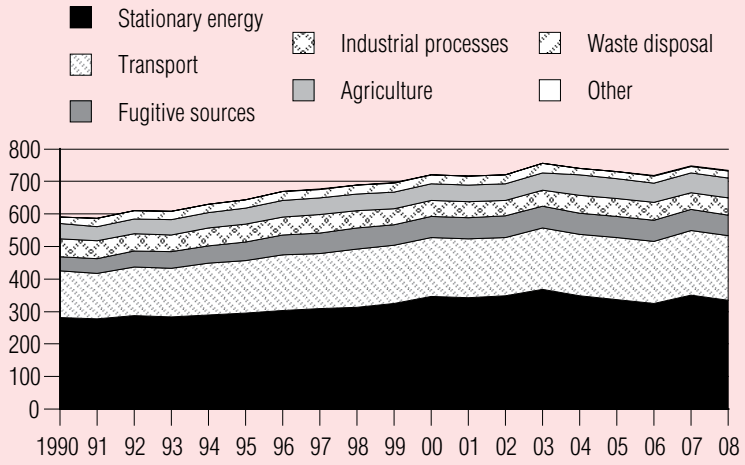
A declining trend in emissions intensity may delay the date at which a critical concentration is reached, but as long as emissions are rising, we continue to approach a tipping point.

Emissions intensity measured by GHG emissions per dollar of real GDP is shown in Chart 3. By this measure, Canada's performance has improved steadily since 1990, with emissions intensity falling by 23 per cent. However, two caveats apply. First, emissions intensity varies significantly between industries. Second, and more importantly, because GDP growth has outpaced intensity improvements, emissions have risen by more than 25 per cent since 1990. The comparison between charts 1, 2, and 3 provides an important context when considering the effectiveness of intensity-based programs and regulations.

Global warming is influenced by the overall concentration of GHGs in the atmosphere. A declining trend in emissions intensity may delay the date at which a critical concentration is reached, but as long as emissions are rising, we continue to approach a tipping point. Intensity measures and intensity-based targets are a better measure of the economic impacts resulting from climate action plans, whereas total emissions are a better measure of the impact on the environment.

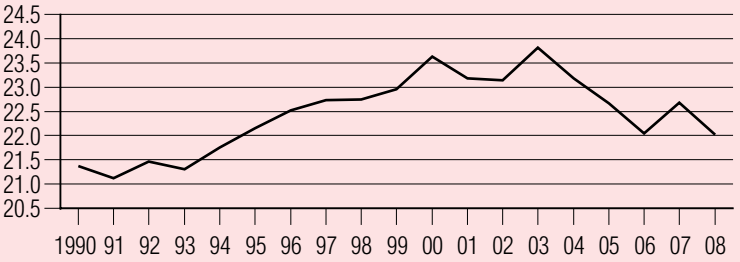
Chart 4 shows GHG emissions by broad category for each province and territory in Canada. The two largest contributors are Alberta (primarily because of stationary energy emissions) and Ontario (both stationary energy and transportation emissions). Quebec ranks third in total emissions because of its large population (stationary emissions from using energy in buildings), its manufacturing base, and transportation of goods and people.

Chart 1
Canada's GHG Emissions by Category
(million tonnes carbon dioxide equivalent)



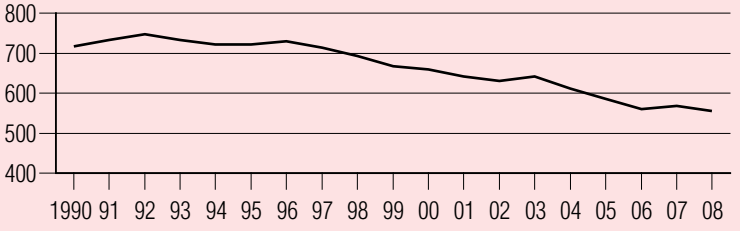
Sources: Environment Canada; The Conference Board of Canada.

Chart 2
Per Capita GHG Emissions
(tonnes per person)



Sources: Environment Canada; Statistics Canada; The Conference Board of Canada.

Chart 3
GHG Emissions Intensity
(kilograms per $ 000s of real GDP)

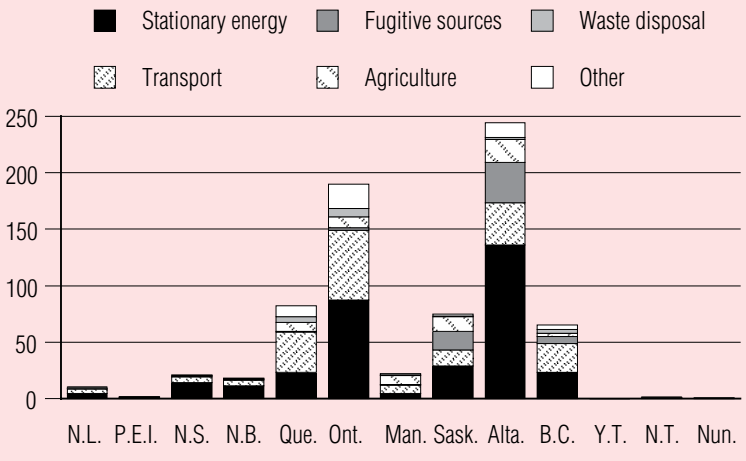


Sources: Environment Canada; Statistics Canada; The Conference Board of Canada.

Saskatchewan ranks fourth despite its smaller population base, primarily because of emissions from energy production. British Columbia is the fifth major contributing province because of its population size, hydrocarbons production, and transportation. The remaining provinces and territories contribute only minor levels of GHG emissions.

As Chart 4 indicates, the challenges for each province vary in terms of both size and sector. Alberta and Ontario must take the lead in reducing emissions if aggressive national targets are to be met. Quebec, Saskatchewan, and British Columbia must also contribute significantly. However, each province faces its own specific challenges based on industrial composition, population, population density, and other factors. One of the challenges Canada faces is to implement programs and initiatives that apply broadly to emissions across the country, while at the same time allowing sufficient flexibility to respond to provincial circumstances. To date, provincial programs have taken centre stage, with support in certain areas from federal initiatives. This decentralized approach raises questions about the incremental costs and regulatory burdens faced by companies operating across the country. It also raises questions about the administrative costs of diverse initiatives, investment programs, and regulatory systems.

Chart 4
Emissions by Category by Province or Territory, 2008
(million tonnes)



Sources: Environment Canada; Statistics Canada; The Conference Board of Canada.

STATIONARY ENERGY (INCLUDING FUGITIVE SOURCES)

Stationary energy sources represent the single largest category of GHG emissions in Canada. These emissions relate to the way Canadians produce, process, transform, transport (primarily via pipeline or electricity transmission line), or consume energy (excluding consumption for transportation). The primary sub-categories are electricity and heat production, fossil fuel production and refining, mining and oil and gas extraction, manufacturing, construction, commercial and institutional energy use, residential energy use, and agriculture and forestry (excluding land-use changes). (See Chart 5.)

Residential, commercial, and institutional GHG emissions related to stationary energy arise primarily because of energy services required by buildings. The largest contributor is space heating, water heating, and cooking that doesn't use electricity. Lighting and appliances that use electricity do not emit GHGs directly, as the emissions related to electricity generation are captured in the category of electricity and heat production. As a result, the emissions in the residential, commercial, and institutional category represent direct emissions only and understate the total impact of these sectors on Canada's GHG emissions.

Residential, commercial, and institutional GHG emissions related to stationary energy arise primarily because of energy services required by buildings.

Fugitive emissions are associated with mining and with oil and gas processing (primarily the latter). In oil and gas production and processing industries, there are several primary sources of fugitive emissions. Oil and gas field operations result in minimal emissions from the unintentional release of hydrocarbons to the atmosphere (venting or field losses) and intentional combustion of hydrocarbons that are present in quantities too small to be commercially viable (flaring). Some flaring also occurs as part of maintenance for some field facilities. Refineries account for minor fugitive emissions, as do pipelines. The largest source of fugitive emissions occurs in natural

gas processing. In its raw form, natural gas often contains carbon dioxide. Most natural gas produced in Canada contains less than 5 per cent carbon dioxide, but some can contain as much as 30 per cent. Because it is potentially corrosive to pipelines and does not contribute to the energy content or value of natural gas, carbon dioxide is removed from the raw natural gas at processing plants and vented to the atmosphere.

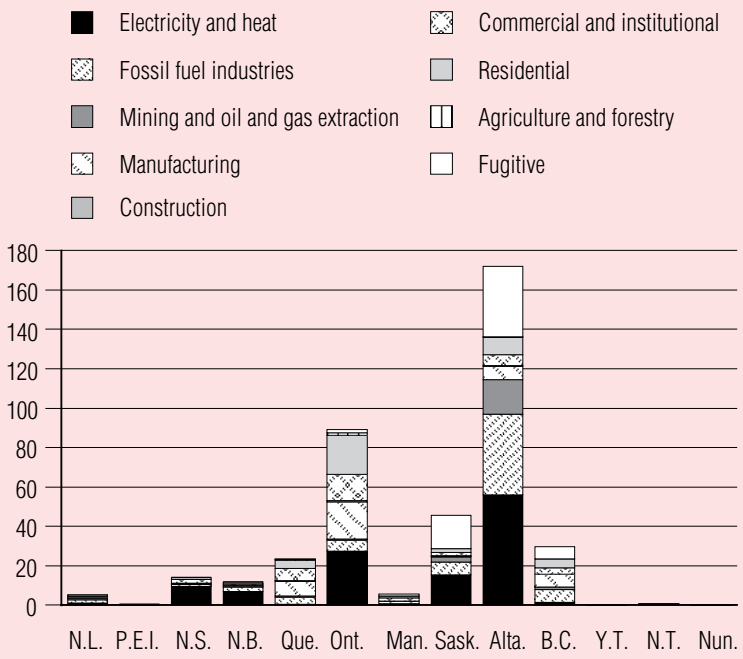
Alberta and Ontario show by far the highest level of GHG emissions from stationary energy.

GHG emissions related to stationary energy plus fugitive emissions accounted for 54 per cent of Canada's total GHG emissions in 2008. These emissions rose at an annual rate of 2.4 per cent from 1990 to 2000, then declined 0.4 per cent per year through 2008. Although the pattern varies by province and territory, nationally the largest contributors are electricity generation from fossil fuels, the oil and gas industry, residential and commercial buildings, and manufacturing.

At a provincial level, Alberta and Ontario show by far the highest level of GHG emissions from stationary energy. Alberta, Ontario, Saskatchewan, Nova Scotia, and New Brunswick emit the largest quantities of GHGs from power generation—primarily from coal-fired stations, with some fuel oil in New Brunswick. Alberta, British Columbia, Saskatchewan, Nova Scotia, and Newfoundland emit GHGs in fossil fuel production activities. The same provinces also emit GHGs as part of refining (as do Ontario, New Brunswick, and Quebec). Alberta, Saskatchewan, and British Columbia are the primary sources of emissions from natural gas processing.

Alberta's largest sources of stationary emissions come from oil and gas production (including fugitive emissions) and electricity production. These two categories together accounted for 55 per cent of stationary energy emissions and 39 per cent of total provincial emissions in 2008. Since 1990, emissions from oil and gas production (including fugitive emissions) have increased by 2.2 per cent annually, and emissions from electricity

Chart 5
Stationary and Fugitive Emissions by Category by Province or Territory, 2008
(million tonnes)



Sources: Environment Canada; Statistics Canada; The Conference Board of Canada.

generation have grown by 1.8 per cent annually. The growth in oil sands production, particularly in the form of in situ (underground) projects that generate large amounts of steam, has been a major source of increasing emissions. Natural gas production increased steadily in the 1990s and through the early 2000s as well, but appears to have reached a plateau and even begun to decline. Some moderation in the overall growth rate might be expected over the coming decade as a result of slower expansion in oil sands production and continued stability or decline in natural gas production. Emissions from electricity production in Alberta also reflect a changing path. Electricity-related emissions rose by 2.6 per cent annually between 1990 and 2000, but that growth rate has decelerated to a 0.9 per cent average annual increase since. One key contributor to this trend has been the increasing share of electricity generated in Alberta from renewable energy sources, primarily wind power, and the increasing importance of natural-gas-fired generation

(where emissions are substantially lower than coal). Pending regulations that could require future coal-fired projects to reduce emissions to the level currently achieved by natural gas generators would reinforce the trend and could even reduce emissions from this sector as coal-fired plants are retired or refurbished over the next 20 years.

Ontario intends to eliminate coal-fired electricity by 2014, an accomplishment that should reduce electricity-related emissions below their 1990 level.

Other sectors of the economy, such as manufacturing, construction, and services, contribute relatively small levels of emissions in Alberta, as does energy consumption related to residential and commercial buildings.

Ontario's stationary energy emissions profile is somewhat different than Alberta's primarily because of its different industrial composition and much larger population. Stationary energy (including fugitive emissions, which are very small) accounted for 48 per cent of total emissions in 2008, with residential and commercial buildings, electricity generation, and manufacturing contributing 91 per cent of total emissions from stationary energy categories. Emissions from the manufacturing sector have declined gradually but steadily since 1990, by about 1 per cent per year. Emissions from residential and commercial sources increased by 2.1 per cent per year from 1990 to 2000, with the growth tapering to 0.4 per cent per year since 2000. Other industrial sectors have contributed only a small amount of stationary energy emissions.

The remaining stationary emissions in Ontario come from electricity and heat generation, which has been an evolutionary story in Ontario. In the 1990s, growing population, electricity restructuring, nuclear station refurbishment, and other factors combined to increase Ontario's reliance on coal-fired electricity. GHG emissions from that sector rose from 26.6 million tonnes in 1990 to 42.8 million tonnes in 2000, an average annual growth of 4.9 per cent. By 2008, emissions had fallen to 27.4 million tonnes, just 3 per cent above their 1990 level, as nuclear stations came back online, natural gas generation replaced coal, and policies to increase the share of renewable generation began to take hold. Ontario intends to eliminate coal-fired electricity by 2014, an accomplishment that should reduce electricity-related emissions below their 1990 level.

Saskatchewan's stationary energy emissions profile is similar to Alberta's in that coal-fired electricity and emissions from oil and gas production dominate. Stationary energy emissions accounted for 38.5 per cent of Saskatchewan's 75 million tonnes of GHG emissions in 2008 (down from 44 per cent in 1990), with coal-fired electricity generation accounting for 53 per cent of stationary energy emissions. The oil and gas sector contributed an additional 31 per cent, and residential and commercial uses contributed 12 per cent. The overall trend growth of 3.4 per cent per year from 1990 to 2000 slowed sharply to 0.8 per cent annually from 2000 to 2008, with each of the major sub-categories reducing its growth. Residential and commercial energy emissions fell in absolute terms between 2000 and 2008, although the drop was small.

British Columbia presents a unique profile for stationary energy emissions in that its electricity generation is dominated by large hydro projects that have very low emissions levels, yet oil and gas production contributes significantly to provincial emissions. British Columbia produces significant amounts of acid gas (that is, gas with high levels of carbon dioxide or hydrogen sulfide), making fugitive emissions from natural gas processing a significant source. Emissions from stationary energy accounted for 46 per cent of British Columbia's total emissions in 2008 and 48 per cent of the growth since 1990. Oil and gas production contributes 46 per cent of stationary energy emissions, residential and commercial uses 26 per cent, manufacturing 22 per cent, and other industries the remaining 6 per cent. As in other provinces, the growth rate has tapered off significantly since 2000.

Quebec's GHG emissions are unique in that the 2008 level was just below the 1990 level. Stationary energy emissions accounted for just 28 per cent of total 2008 emissions, with residential and commercial uses resulting in 44 per cent of stationary energy emissions. The manufacturing sector was second in stationary emissions at

32 per cent, oil and gas plus mining was third at 18 per cent, and all other sectors contributed the remaining 6 per cent of stationary energy emissions.

The four Atlantic provinces combined accounted for only 51 million tonnes of GHG emissions in 2008, and less than 32 million tonnes of stationary-energy-related GHG emissions. Thermal electricity generation and fossil fuel production contributed most of the emissions that did not come from energy consumption in buildings (except in Prince Edward Island).

Northwest Territories, Yukon, and Nunavut emit very small quantities of GHGs, with stationary energy emissions accounting for just under half of the total. Thermal power generation, buildings, and oil and gas production in Yukon and Northwest Territories are the primary sources of emissions. Both Yukon and Northwest Territories show lower total GHG emissions and lower stationary energy emissions in 2008 than in 1990.

Northwest Territories, Yukon, and Nunavut emit very small quantities of GHGs, with stationary energy emissions accounting for just under half of the total.

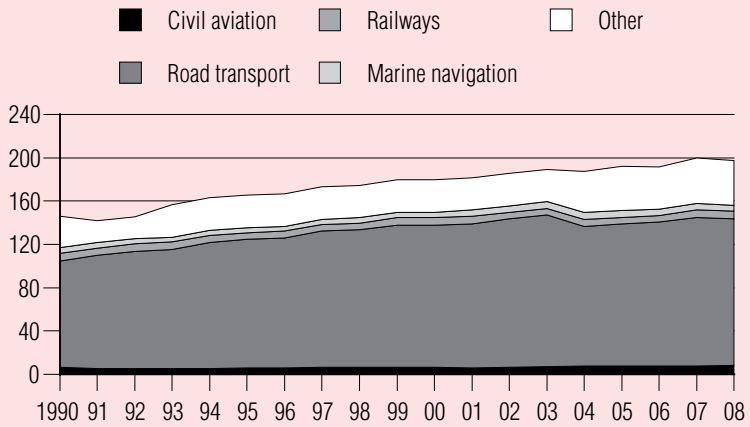
Overall, the regional trends show a fairly consistent trend of rising emissions between 1990 and 2000, with more moderate growth or even reductions since 2000. The manufacturing sector shows a consistent decrease over the entire period.

TRANSPORTATION

The transportation sector includes a broad range of emissions related to moving people (in passenger vehicles, public transit, and air) and goods (by road, rail, water, and air). It involves myriad transport modes and objectives, and has millions of emissions sources—vehicles.

In 2008, transportation accounted for 198 million tonnes of GHG emissions, or 27 per cent of Canada's total. Transportation emissions increased at an annual rate of 1.75 per cent between 1990 and 2008. Per capita transportation emissions were 6 tonnes per person per year

Chart 6
Transportation Emissions in Canada, 1990–2008
(million tonnes)



Sources: Environment Canada; The Conference Board of Canada.

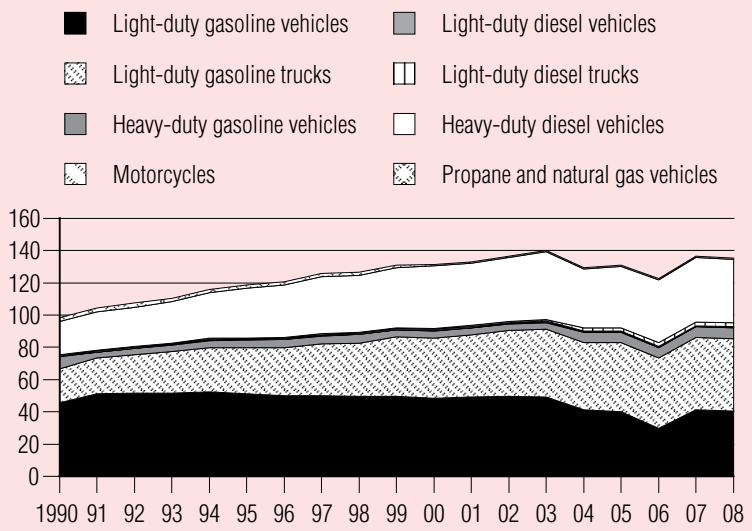
in 2008. As shown in Chart 6, road transportation contributed the most, at 68 per cent of total transportation emissions. The category "other" transportation in Chart 6 includes off-road transportation (mainly heavy-duty vehicles used at industrial facilities) and pipelines. The apparent decline in road transportation emissions and increase in off-road transportation between 2003 and 2004 is the result of data reclassification.

Within the road transport sector, emissions trends result from vehicle choices and from increasing vehicle use. Road transportation emissions are shown by vehicle type in Chart 7. Heavy-duty vehicles accounted for 34 per cent of total emissions in 2008, up from 29 per cent in 1990. Within the light-duty fleet of vehicles on the road, there has been a clear increase in the volume and share of emissions from light-duty trucks versus light-duty automobiles. The light-duty truck category includes minivans, crossovers, sport utility vehicles, and pickup trucks. Over the period shown, the increasing share of light-duty vehicle emissions from trucks reflects the growth in popularity of these types of vehicles.

Emissions from almost every category of vehicles were larger in 2008 than in 1990. The exception was light-duty gasoline automobiles, which showed a significant decline, from 45.8 million tonnes of GHG emissions in 1990 to 40.6 million tonnes in 2008—even though the number

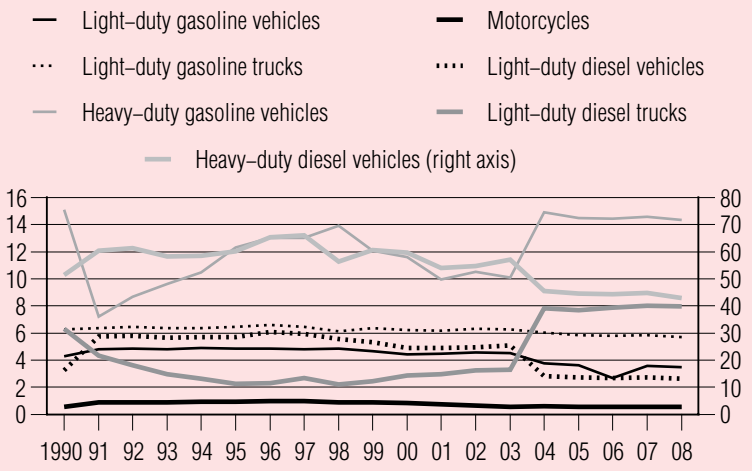
of light-duty gasoline automobiles on the road increased from 10.6 million in 1990 to 11.7 million in 2008. The combination of a larger fleet and lower emissions suggests that these vehicles are becoming more efficient, or that Canadians are using them less (fewer kilometres per vehicle), or perhaps both.

Chart 7
Road Transportation Emissions by Vehicle Type, 1990–2008
(million tonnes)



Sources: Environment Canada; The Conference Board of Canada.

Chart 8
Road Transportation Emissions Per Vehicle, 1990–2008
(tonnes per vehicle)



Sources: Environment Canada; The Conference Board of Canada.

Chart 8 shows the trend for emissions per vehicle for light-duty and heavy-duty categories, separating gasoline-powered from diesel vehicles. Emissions per vehicle reflect operating characteristics, vehicle characteristics, kilometres driven, vehicle efficiency, and other factors. For light-duty vehicles, over the 18 years shown, emissions per vehicle declined moderately in all categories except light-duty diesel trucks. The drop in emissions per vehicle from both light-duty gasoline automobiles and light-duty gasoline trucks suggests that the primary reasons for the rise in total emissions from light-duty vehicles have been the switch from autos to trucks and, more importantly, the increasing number of light-duty vehicles on the road.

The challenge is to find a path that improves vehicle performance, changes consumer behaviour, and reduces emissions as the economy and population continue to expand.

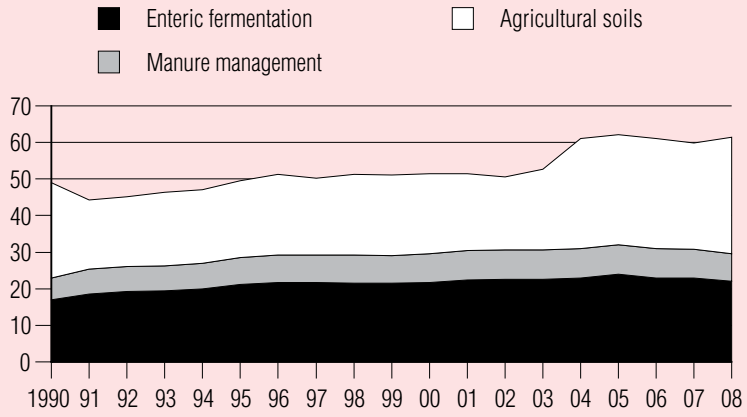
The trends shown in Chart 8 for heavy-duty vehicles are somewhat different. Overall, emissions per vehicle for heavy-duty gasoline vehicles were similar in 1990 and in 2008, with an apparent shift in 2004 as a result of data reclassification or a change in methodology. For heavy-duty diesel vehicles, there has been a downward trend since the mid-1990s. This category includes freight trucks and buses, for urban and highway use.

Transportation-related GHG emissions demonstrate clearly one of the challenges Canada faces in mitigating global warming. In the case of light-duty passenger vehicles, total emissions have been rising steadily as growth in the number of vehicles on the road and the distances travelled has been more rapid than fuel efficiency improvements. This has been exacerbated by the shift in consumer preferences from automobiles to vans, SUVs, and trucks. Total emissions from heavy-duty vehicles have also increased steadily, even though emissions per vehicle have dropped noticeably. The challenge is to find a path that improves vehicle performance, changes consumer behaviour, and reduces emissions as the economy and population continue to expand.

INDUSTRIAL PROCESSES

GHG emissions from industrial processes are generated through the production of minerals (cement and lime), chemicals (ammonia, nitric acid, and adipic acid), and metals (iron and steel, aluminum, and magnesium). This category accounts for emissions from these processes that are not related to the use of energy. Industrial processes contributed 52.6 million tonnes of GHG emissions in 2008, or 7 per cent of total emissions. The share decreased slightly from 1990, when emissions from this sector were 54.8 million tonnes, or 9 per cent of total emissions. Most of this decrease was due to a significant reduction in emissions from Canada's lone production facility for adipic acid, which is used to make nylon. Ontario accounted for just over 40 per cent of total industrial process emissions in 2008, with Alberta contributing 25 per cent and Quebec just under 18 per cent.

Chart 9
GHG Emissions From Agriculture
(million tonnes)



Sources: Environment Canada; The Conference Board of Canada.

Alberta, Saskatchewan, Ontario, and Quebec contribute 82 per cent of Canada's total emissions in the agriculture category.

AGRICULTURE

Non-energy GHG emissions in agriculture come from three main sources: enteric fermentation (animal digestion), manure management, and soils. (See Chart 9.) The apparent rise in soils emissions in 2004 can be attributed to revision in the estimation methodology rather than changes in soil management practices. As Chart 9 shows, agricultural emissions have increased very slowly through time, particularly in response to farm animal populations, notwithstanding improved practices to reduce emissions intensities. Alberta, Saskatchewan, Ontario, and Quebec contribute 82 per cent of Canada's total emissions in this category.

WASTE MANAGEMENT

The final category of GHG emissions covers those from waste management. This category includes waste-water processing (primarily sewage treatment), incineration, and landfills, with the latter accounting for 90 per cent of the category total. Emissions from waste management are influenced by population and by the relative importance of primary industries in the provincial economies.

CHAPTER 3

Climate Action Plans and Regulatory Measures

Chapter Summary

- Each province has set a GHG reduction target and established a climate action plan specific to its own circumstances. Most provinces have coordinated their climate action plans with an energy strategy.
- The action items in the provincial plans align well with the sources of emissions that need to be reduced in each province.
- Based on historical data, there is a strong need for each province to improve performance to meet targets for 2020.
- National actions on tailpipe emissions and electricity generation emissions are expected to complement provincial actions.

Each of Canada's provinces and territories has developed and implemented a climate action plan and set targets for emissions reductions. The federal government has also taken initiatives and developed programs in many areas. The climate action plans are linked to programs and policies, whose details depend on the nature of the emissions challenges they are intended to address. Table 1 summarizes the key measures taken.

Eight of the ten provinces and two of three territories have both a climate action plan and an energy plan. Energy plans have a key role to play in reducing GHG emissions, given that energy production and consumption account for 82 per cent of GHG emissions in Canada. Developing renewable energy also charts prominently in the policy objectives. Quebec, Manitoba, and British Columbia already rely heavily on large-scale hydro plants for their electricity. Ontario and Newfoundland and Labrador are taking action to reduce their use of fossil fuels for power generation. Energy efficiency programs for vehicles and for buildings also play a central role in federal, provincial, and territorial initiatives.

Canada's federal targets for emissions management and reduction have been slow to develop and not clearly stated or strongly supported.

However, it is clear from the emissions profiles presented in Chapter 2 that having an action plan and developing measures does not guarantee reduced emissions. Canada's federal targets for emissions management and reduction have been slow to develop and not clearly stated or strongly supported. Canada's commitment to and failure to deliver on its Kyoto targets is well documented. In the absence of a unified and supported federal target, the provinces have each established their own reduction

Table 1
Climate Action Policies and Measures

Measure	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nun.	Canada
Energy plan	√	√	√			√	√	√	√	√	√	√		
Climate action plan	√	√	√	√	√	√	√	√	√	√	√	√		√
Develop renewable resources	√	√	√	√	√	√	√	√	√	√	√	√		√
Hydrocarbon development action plan	√								√					
Sustainability plan	√	√	√	√		√			√	√				√
Develop energy for export	√				√		√		√					√
Clean electricity (clean coal)	√					√		F	√					√
GHG reduction target	√	√	√	√	√	√	√	√	√	√	√	√		√
Energy conservation programs—buildings	√	F	√	√	√	√	√	√	F	√	√	√		√
Energy efficiency programs—vehicles	√		√		√	√	√			F	√	√		√
Public awareness programs	√		√	√	√	√	√	√	√	√		√		√
Climate registry	F					√	√		√		√			√

√ = measure in place
F = planned for the future
Source: The Conference Board of Canada.

target and timing. Table 2 demonstrates this diversity. Canadian consumers and businesses face a myriad of definitions, targets, and timelines that require them to consider a broad range of factors in their purchasing and business decisions. In addition, specific provincial objectives have tended to be moving targets—although recently, legislated actions have become more common and have imposed more absolute deadlines.

Although there is no clear alignment among all the provincial definitions of reduction targets or timing, there is reasonably strong alignment among the programs and policies that have been put in place, as shown in Table 3. The provinces and territories are using a combination of fiscal incentives in the form of carbon taxes, fuel taxes, tax incentives, capital grants, and technology funding. Programs to support building efficiency, vehicle efficiency, general energy efficiency, public transit, public education, etc. are common tools. The specifics of each climate action plan depend on the challenges, political realities, and economic circumstances of the province or territory.

Jurisdictional diversity means that consumers or businesses must focus on each jurisdiction independently.

The programs and measures listed in Table 3 vary significantly between jurisdictions. Each province or territory has chosen its own path in terms of the expenditure level, the sources of funding, the timing of expected results, and the way in which progress is measured. This diversity

Table 2
Provincial Emissions Reduction Programs and Targets

Province or territory	Reduction targets
British Columbia	◆ 6 per cent below 2007 levels by 2012 ◆ 18 per cent below 2007 levels by 2016 ◆ 33 per cent below 2007 levels by 2020 ◆ 80 per cent below 2007 levels by 2050
Alberta	◆ 20 million tonnes by 2010 ◆ 50 million tonnes by 2020 ◆ 200 million tonnes by 2050
Saskatchewan	◆ 20 per cent below 2006 levels by 2020
Manitoba	◆ 6 per cent below 1990 levels by end of 2012
Ontario	◆ 6 per cent below 1990 levels by 2014 ◆ 15 per cent below 1990 levels by 2020 ◆ 80 per cent below 1990 levels by 2050
Quebec	◆ 20 per cent below 1990 levels by 2020
Nova Scotia	◆ 10 per cent below 1990 levels by 2020 ◆ up to 80 per cent below current levels by 2050
New Brunswick	◆ 10 per cent below 1990 levels by 2020 ◆ 5.5 million tonnes below 2007 levels by 2012
Prince Edward Island	◆ 10 per cent below 1990 levels by 2020
Newfoundland and Labrador	◆ 10 per cent below 1990 levels by 2020
Yukon	◆ cap GHG emissions in 2010 ◆ 20 per cent below 2010 levels by 2015 ◆ carbon neutral by 2020
Northwest Territories	◆ 10 per cent below 2001 levels by 2012, with targets under review in 2011
Nunavut	◆ control and reduce GHG emissions during the 10 years between 2003 and 2013

Note: Targets in Yukon and Northwest Territories apply to government operations only, not to the territories in general.
Sources: The Conference Board of Canada; provincial climate action plans.

Table 3
Climate Action Programs and Policies

Measure	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nun.	Canada
Corporate tax incentives		F				√	√	√		√				√
Carbon tax					√					√				
Fuel tax					√					√				
Capital subsidies—businesses			√	√	√	√	√	√	√	√	√	√		√
Capital subsidies—consumers	√	√	√		√	√	√	√	√	√	√	√		√
Technology R&D delivery	√					√		F	√			√		√
Technology R&D funding	√	F	√		√	√	√	F	√			√		√
Technology implementation funding	√	F	√	√	√	√	√	F	√			√		√
Cap on emissions			√		F	F	F	F		F	F			F
Cap on emissions intensity									√					
Mandatory emissions reporting			√		√				√	F	F			√
Voluntary emissions reporting									√					√

(cont'd on next page)

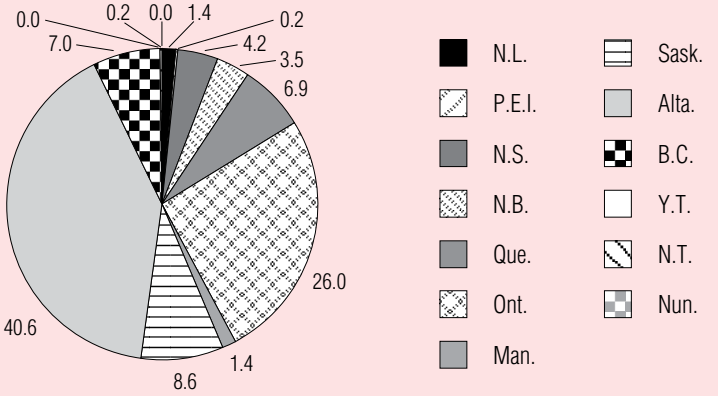
Table 3 ***(cont'd)***
Climate Action Programs and Policies

Measure	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nun.	Canada
Emissions trading in place			F		F	F	F	F	√	F				F
Renewable electricity program	√	√	√	√	√	√			√	√	√	√		√
Renewable fuel standards—gasoline		F		F	√	√	√	√	√	F				√
Renewable fuel standards—diesel		F		F	√	?	√	√	√	√				√
Vehicle efficiency standards		F	√	F	√	F				√	F	F		F
Building efficiency standards	√	F	√	√	√	√	√	√	√	√	√	√		√
Updated building code		F	F	√	F	√	√	F	F	√	F	F		F
Energy efficiency funding	√	√	√	√	√	√	√	√	√	√	√	√		√
Renewable energy funding	√	√	√	√	√	√	√	√	√	√	√	√		√
Renewable energy targets	√	√	√	√	√	√	√	√	√	√	√	√		√
Offsets program	F					F	√	√	√	√	F			F
Public transit plan and funding	F	F	F	√	√	√	√	√	F	√				
Vehicle rebates for low or zero emissions	F	√			√	√		√		√	F	√		√
Greening government fleet	√	√	√	√			√	√	√	√	F	√		
Greening government buildings	√	F	√	√	√	F	√		√	√	F	√		√
Public education campaigns	F	F	√	√	√	√	√	√	√	√	√	√		√
Support for municipalities	√		√	√	√	√	√	√	√	√	√	√		
Industry GHG reduction programs and funding	F	F	√	√	√	√	√	√	√	√	√	√		√
Green procurement	√	√	√	√		F	√		F	√	F	√		
Vehicle idling restrictions			Gov't	F		F				F	F	F		
Vehicle idling information campaigns	√		√	√	√	√		√	F	√	√	√		
Management of GHGs from waste	F	F		√	√	√	√		√	√	√	√		
Agriculture program		F		√	√	F	√	F	√	√	F			
Land-use plans that reflect action on climate change		F							F	F	F			
Vehicle emissions standards			√	F		F	√			F	F			F
Forest strategy that reflects action on climate change			F	F		√	√	F	F	√	F	√		

√ = measure in place
F = planned for the future
Gov't = measure applies to government only
Sources: provincial climate action plans; The Conference Board of Canada.

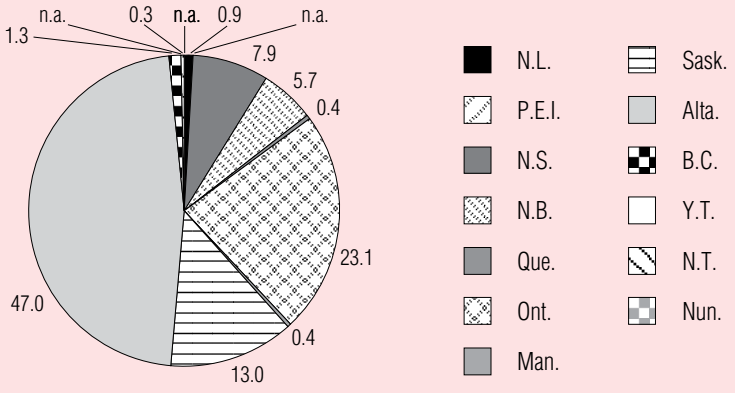
means that consumers or businesses that wish to participate in the programs or investments must focus on each jurisdiction independently. The added cost and time burden this creates is one of the themes of this report. The rest of this chapter describes the major initiatives to address emissions in each of the categories presented in Chapter 2. The primary focus is on jurisdictions that face the greatest challenge in each category.

Chart 10
Shares of Stationary Energy Emissions, 2008
(per cent)



Sources: Environment Canada; The Conference Board of Canada.

Chart 11
Electricity and Heat Emissions, 2008
(per cent)



n.a. = not available.
Sources: Environment Canada; The Conference Board of Canada.

STATIONARY ENERGY (INCLUDING FUGITIVE SOURCES)

Alberta, Ontario, Saskatchewan, Quebec, and British Columbia contribute 89 per cent of Canada's stationary energy emissions. (See Chart 10.) As described in Chapter 2, the sources of these emissions vary significantly among jurisdictions. As a result, any evaluation of climate action plans must focus on the sub-categories. For example, British Columbia contributes the fourth largest share of stationary emissions despite having very little thermal power generation—primarily because of emissions related to its oil and gas industry. Quebec is fifth largest in stationary energy emissions, with an electric system that is based almost entirely on large hydro, nuclear, and wind power. Manufacturing, construction, and buildings contribute the largest stationary emissions in that province.

The path forward in Alberta includes emissions regulation, public and private investments in technology (including CCS), and continued exploitation of the province's fossil fuel generation base load.

ELECTRICITY AND HEAT PRODUCTION

Five provinces—Alberta, Ontario, Saskatchewan, Nova Scotia, and New Brunswick—contributed almost 97 per cent of reported GHG emissions from electricity and heat production in 2008. P.E.I., Nunavut, and Yukon do not have reported data for that year. In 2008, Alberta generated 82 per cent of its electricity from coal,[1] Saskatchewan 60 per cent,[2] Nova Scotia 65 per cent,[3] and New Brunswick 50 per cent from coal and fuel oil combined.[4] Although Ontario relies much less in percentage terms on coal than the other provinces do, it still ranks second in GHG emissions from coal generation.

1 Environment Canada, *National Inventory Report 1990–2008*, Table A13-10.

2 Ibid., Table A13-9.

3 Ibid., Table A13-4.

4 Ibid., Table A13-5.

Previously, Alberta's policy was to remain entirely technology neutral with regard to electricity generation. The provincial energy strategy now refers to increasing the role of electricity from renewable sources, but points out that additional transmission capacity must be built to make this possible. The energy strategy also encourages the combination of "carbon-rich" fuels to generate electricity plus carbon capture and storage (CCS) to reduce GHG emissions while increasing electricity production.[5] The Alberta Electric System Operator (AESO) identifies a need for 11,500 megawatts of additional generation capacity to replace units that are scheduled to be retired over the next 20 years and to accommodate growth.[6] Alberta is investing heavily in CCS technology with the expectation that it will help reduce GHG emissions in the province. Project Pioneer is one of the initial projects that has been funded by the federal government, Alberta, and private sector project sponsors. This project is intended to capture 1 million tonnes per year of GHG emissions from the Keephills 3 power station, beginning in 2015.

In Alberta, as of the end of 2008, emissions had been reduced by 10 Mt cumulatively.

Alberta has also implemented GHG emissions intensity limits on facilities emitting 100,000 tonnes of GHGs per year or more. The *Specified Gas Emissions Act* and the associated Specified Gas Emissions Regulation (SGER) require facilities to report their emissions and to comply with the intensity targets. In 2007, the first full year of regulation, 106 facilities reported a total of 114.4 million tonnes of GHG emissions, of which 43 per cent came from utilities (electric and natural gas).[7] As of the end of 2008, emissions had been reduced by 10 Mt cumulatively, although the reduction from electricity generation was not specified.[8] Alberta is also home to Canada's coal-fired generating station with the lowest emissions, Genesee 3, which is operated by Capital Power and jointly owned with TransAlta Corporation. The 495-MW plant uses supercritical combustion technologies, flue gas desulphurization, particulate filters, and high fuel efficiency to reduce GHG emissions by 24 per cent as compared with Alberta's average coal-fired plant.[9]

The path forward in Alberta includes emissions regulation, public and private investments in technology, and continued exploitation of the province's fossil fuel generation base load—that is, generation required to meet the minimum of power necessary in the province. Renewable energy from wind, biomass, and hydro will also contribute.

Ontario's electricity-related GHG emissions also come from fossil fuel generation, both coal (80 per cent) and natural gas (20 per cent). Ontario has taken an entirely different approach than Alberta by planning for "coal-fired generation in Ontario to be replaced by cleaner sources in the earliest practical time frame that ensures adequate generating capacity and electricity system reliability in Ontario."[10] The phase-out of coal-fired generation would reduce emissions by up to 27.7 million tonnes as compared with 2008, depending on the replacement technology. Natural gas generation would reduce emissions by almost half as compared with coal, based on average emissions per kilowatt hour of electricity generated. Ontario has also implemented a Renewable Energy Standard Offer Program (which is no longer contracting for new capacity) and a Feed-In Tariff Program. These programs provide incentives for renewable generation and form a key element of Ontario's plan for future generation capacity.

In 2008, Saskatchewan emitted 15.4 Mt of GHGs through power generation, although the data by generation technology are not published. Saskatchewan's installed capacity is primarily coal-fired, with 63 per cent of 2008 generation from coal-fired units. Only 16 per cent was from hydro and biomass. SaskPower, the Crown-owned generator, has avoided building new coal-fired generation

5 Government of Alberta, *Launching Alberta's Energy Future*, 53.

6 Alberta Electric System Operator, *AESO Long-Term Transmission System Plan*, 2.

7 Alberta Environment, *Alberta Environment Report on 2007 Greenhouse Gas Emissions*, iv.

8 Government of Alberta, *Alberta Realizes 6.5 Million Tonnes of GHG Reductions*.

9 TransAlta, "Genesee 3."

10 Ontario Ministry of Energy, "Electricity Homepage."

units since 1992 and has added natural gas, wind, and heat recovery energy instead.[11] SaskPower is considering a range of options for future capacity additions, including nuclear energy. The government does not have an explicit target for generation emissions reduction, but is making technology investments in CCS. The *Management and Reduction of Greenhouse Gases Act*, if fully implemented, would create additional vehicles for investment in emissions-reducing technologies in Saskatchewan.

Nova Scotia's legislation requires that 18.5 per cent of the province's electricity must come from renewable sources by 2013.

Nova Scotia's GHG emissions from electricity come from both coal and fuel-oil generators. In 2008, coal generation accounted for 60 per cent of the provincial total, and fuel-oil generators accounted for 30 per cent. The provincial climate action plan identifies Nova Scotia Power as the source of 46 per cent of total GHG emissions in the province.[12] Provincial legislation requires that by 2013, 18.5 per cent of the province's electricity must come from renewable sources[13] (up from 9 per cent in 2004). In 2009, the government passed regulations that apply to all power generation facilities emitting 10,000 tonnes of GHGs per year or more. The regulations set a cap on total emissions from regulated facilities at 19.22 million tonnes over 2010–2011 (an average of 9.61 Mt per year), 18.5 Mt over 2012–2013, trending down to 7.5 Mt in 2020.[14] This is still higher than the 6.8 Mt of emissions recorded for 1990, falling short of Nova Scotia's overall goal of a 10 per cent reduction in emissions from 1990 levels by 2020.[15] Additional measures will be required to meet the overall target. Some of these measures have been identified, including energy efficiency, conservation, increased reliance on natural gas, distributed generation, CCS, and increased imports from non-emitting sources.[16] Additional transmission capacity for renewable energy is also a major focus of Nova Scotia's green electricity program.

New Brunswick's electricity generation emitted 6.8 million tonnes of GHGs in 2008. The province's *Climate Change Action Plan 2007–2012* includes broad goals of increasing the contribution of energy efficiency and low-emissions generation sources in order to reduce emissions from electricity generation. The combined contribution of these two actions is an anticipated reduction of 2.2 Mt of GHG emissions in 2012, although the split between conservation and low-emissions generation is not identified.[17] The action plan does not clearly define whether the reduction target is to below 2012 emissions that might take place, or to below 2007 levels. The renewable energy options identified are biomass, solar, wind, and tidal energy.[18]

Other provinces are working to reduce GHG emissions from electricity generation, albeit from very low initial levels. Most notable is Newfoundland and Labrador, whose energy plan includes an explicit goal of using non-renewable resource revenues to develop renewable energy potential.[19] The cornerstone of this initiative would be the development of hydro generation at Lower Churchill and a transmission link to the island.[20] The plan also includes wind generation, additional hydro, and restricting the Holyrood thermal station to burning low-sulphur fuel oil.[21]

11 SaskPower, "Generation Options Being Considered."

12 Nova Scotia Department of Energy, *Toward a Greener Future—Nova Scotia's Climate Action Plan*, 1.

13 Government of Nova Scotia, *Environmental Goals and Sustainable Prosperity Act*, 4 (2) (g).

14 Government of Nova Scotia, Greenhouse Gas Emissions Regulations.

15 Environment Canada, *National Inventory Report 1990–2008*, Table A9-4; Government of Nova Scotia, *Environmental Goals and Sustainable Prosperity Act*, 4 (2) (e).

16 Nova Scotia Department of Environment, *An Approach to Regulating Electricity Sector Greenhouse Gas and Air Pollution Emissions in Nova Scotia*, 5.

17 New Brunswick Department of Environment, *Climate Change Action Plan 2007–2012*, 11.

18 Ibid., 15.

19 Newfoundland and Labrador Department of Natural Resources, *Department of Natural Resources Strategic Plan 2008–2011*, 2.

20 Ibid., 31.

21 Ibid., 38.

The Government of Canada has also announced steps to regulate GHG emissions from the electricity generation sector.[22] The details are not expected to be available until regulations are drafted sometime in 2011, but the regulations will apply to new coal-fired generating stations and to any units that reach the end of their economic life and are refurbished or life extended. These stations will be required to reduce emissions to a level that does not exceed combined-cycle natural gas generators. Of the 51 coal-fired units in Canada, 33 will reach the end of their life by 2025. The proposed regulations would reduce total GHG emissions from coal-fired generation by 15 Mt.[23] This would represent a reduction of 12.6 per cent relative to 2008 emissions from electricity generation, but would still leave emissions in this category 9 per cent above their 1990 level.

The federal government has focused on regulating coal-fired generation, but the regulations have yet to be written, making the impact difficult to measure.

There is no single national strategy or action plan in place to reduce GHG emissions from electricity generation in Canada. The federal government has focused on regulating coal-fired generation, but the regulations have yet to be written, making the impact difficult to measure. Ontario is the only province that has committed to eliminating coal-fired generation. Provinces that use fossil fuels to generate power have been switching from coal generation to natural gas where it is available, as well as to renewable energy. This brings its own set of challenges, because wind and solar power are intermittent in nature, requiring reserve generation capacity and additional transmission capacity. Eliminating coal-fired generation also requires that sufficient alternative sources of electricity exist or can be built—an assumption that has been particularly challenging for Ontario. Very few provinces or territories have presented emission-reduction plans that include increasing their imports of low-emitting hydroelectricity from neighbouring provinces with surplus hydroelectric energy.

22 Environment Canada, *Government of Canada to Regulate Emissions From Electricity Sector.*

23 Ibid., 1.

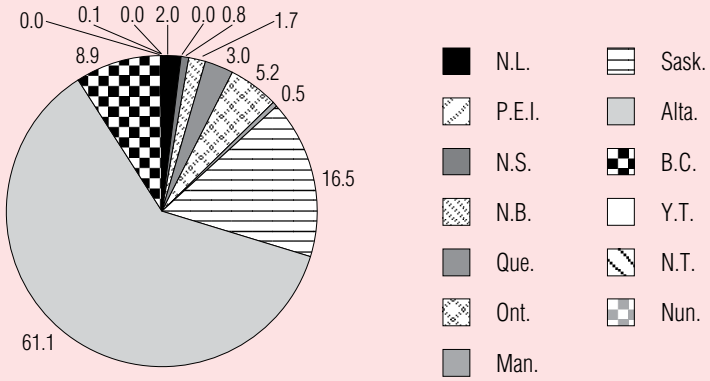
FOSSIL FUEL PRODUCTION, MINING, AND RELATED FUGITIVE EMISSIONS

Besides electricity and heat generation, another major source of stationary emissions in Canada is from fossil fuel production, mining, and related fugitive emissions. This category includes emissions related to oil and gas extraction, mining, natural gas processing, and crude oil upgrading and refining. Total emissions in 2008 were 154.6 Mt, or 21 per cent of total Canadian emissions.

Alberta has already committed $2 billion in government investment in four projects.

The key contributor, as shown in Chart 12, is Alberta, at 61 per cent of category emissions. Alberta is Canada's largest producer of crude oil and natural gas and its only producer of bitumen. Emissions from minerals and metals mining in Alberta are very small. Saskatchewan is the second largest contributor, based on heavy oil production, smaller natural gas production, and a more significant contribution from minerals mining. British Columbia ranks third, primarily because of natural gas production and processing. Ontario and Quebec contribute emissions from refining and petrochemicals production. Newfoundland and Labrador has offshore oil production (and smaller volumes of natural gas), and Nova Scotia produces some offshore natural gas.

Chart 12
Oil and Gas, Mining, and Fugitive Emissions, 2008
(per cent)



Sources: Environment Canada; The Conference Board of Canada.

One of the three goals stated in Alberta's climate change strategy is "to transform the way we produce energy and to introduce cleaner, more sustainable approaches to energy production."[24] The target is to reduce GHG emissions from energy production by 37 Mt by 2050, relative to emissions that would otherwise occur in 2050.[25] It would bring emissions to 14 per cent below 2005 levels. Alberta has already committed $2 billion in government investment in four projects through the Carbon Capture and Storage Fund. Two of the four projects are for power generation CCS, one is for a carbon dioxide pipeline system, and one is for carbon capture from the Scotford ugrader.

Alberta also identifies the Climate Change and Emissions Management Fund (CCEMF) as a source of investment in cleaner energy production technologies. This fund receives the payments made by regulated emitters under the Specified Gas Emissions Regulation from companies that are not able to meet the required intensity reduction and that do not purchase sufficient offset credits to meet their commitments. The Climate Change and Emissions Management Corporation (CCEMC) began allocating the $120 million accumulated in the fund in 2010, and as of the end of June, it had awarded a total of $71.38 million to 16 projects for investments in clean fossil fuel production, CCS, energy efficiency, and renewable energy. (See Table 4 for a list of projects.) About 40 per cent of this funding has gone to cleaner fossil fuel production, including CCS.

Table 4
Investments in Clean Technologies by the Climate Change and Emissions Management Fund

Sponsor	Project	**Funding** ($ millions)
Clean energy from fossil fuels		
E-T Energy	Poplar Creek Project	6.862
ESEIEH Consortium	Enhanced solvent extraction	16.475
Carbon capture and storage		
HTC Purenergy Inc.	CO2 Capture Feed Study for Jackfish SAGD	0.315
GE	Ceramic membrane H2 production with carbon capture	2.000
Suncor Energy Inc.	Once through steam generator demonstration project	2.500
Energy efficiency		
Evergreen Energy Technologies Inc.	Power Pod remote power	0.250
May-Ruben Technologies Inc.	BFE thermal refrigeration system	0.570
Nova Chemicals Corporation	Energy footprint reduction for ethylene production	0.700
Suncor Energy Inc.	Alberta oil sands energy efficiency and GHG mitigation roadmap	0.791
Great Northern Power Corp.	Great Northern Power's expander system	1.570
Genalta Power Systems Inc.	Waste energy to power	1.849
Renewable energy		
Enerkem Inc.	Greening biofuel production	1.800
City of Medicine Hat	Concentrating solar thermal power project	3.000
ECB Enviro North America Inc.	Lethbridge biogas cogeneration project	8.200
Plasco Alberta Inc.	Plasco Alberta energy and waste conversion project	10.000
Enmax Corporation	Home generation	14.500
Total CCEMF funding		71.382

Sources: Climate Change and Emissions Management Corporation; The Conference Board of Canada.

24 Alberta Environment, *Alberta's 2008 Climate Change Strategy*, 7.

25 Ibid., 20.

Alberta Innovates—Energy and Environment Solutions is the government-funded agency with the mandate that includes technology development to reduce the environmental impact of hydrocarbons production. The agency was created at the beginning of 2010 and includes the Alberta Energy Research Institute.[26] Alberta Innovates research priorities include several clean energy supply initiatives: bitumen upgrading, enhanced recovery, clean coal, CCS, and GHG emissions reduction.

Successful development of CCS from natural gas processing plants, if expanded, could significantly reduce fugitive GHG emissions.

Saskatchewan's GHG emissions from mining and oil and gas production are dominated by fugitive emissions, which are responsible for almost two-thirds of them. The largest increases since 1990 have been in oil and gas extraction and related fugitive emissions. Emissions from these two categories have grown at a compound annual rate of 5.7 per cent, attributable to a doubling of crude oil production, steady but moderate growth in natural gas production, and strong growth in the number of operating wells as both heavy oil and natural gas resources have matured and production per well has declined.[27] Notwithstanding the rapid growth in emissions related to oil and gas production, Saskatchewan has only limited resources and initiatives devoted to reducing these emissions and has focused its efforts primarily on CCS. The Weyburn-Midale CO2 monitoring and storage project has been operating for some time, and continues to provide CCS results and research opportunities. Saskatchewan is also studying enhanced recovery and carbon storage opportunities through the Petroleum Technology Research Centre, as well as carbon storage in deep aquifers through Aquistore. The province has also announced an international CO2 test centre.[28]

British Columbia is Canada's second largest producer of natural gas, and also produces crude oil. Upstream emissions come from field operations and natural gas processing. The provincial climate action plan includes an interim target to reduce flaring of natural gas by 50 per cent by 2011.[29] Natural gas flaring occurs when natural gas is produced in association with crude oil, but the volumes are too small to merit recovery and sale. Flaring can also occur during routine maintenance or because of unexpected operating conditions.

GHG emissions also occur as part of natural gas processing. Carbon dioxide is often present in raw natural gas streams and must be removed prior to putting the natural gas into transmission pipelines destined for markets. Natural gas processing plants that must handle CO2-rich gas are equipped with carbon capture technologies, but currently release the CO2 to the atmosphere. Canada, British Columbia, and Spectra Energy are investing in CCS technology through a feasibility study at the Fort Nelson processing plant. If completed, the Fort Nelson project would capture and store 2 million tonnes of GHGs per year. The feasibility study is currently focused on test wells and geological evaluations.[30] Successful development of CCS from natural gas processing plants, if expanded, could significantly reduce fugitive GHG emissions. One of the key success factors will be proximity to a CO2 transmission system or a suitable storage site.

Ontario's and Quebec's fossil fuel production, mining, and related fugitive emissions are primarily from refining crude oil, with larger emissions in Ontario resulting from a larger refining industry. In both cases, the category accounts for about 4 to 5 per cent of total provincial emissions. Neither province has included measures specific to these emissions in its climate action plans.

Although Newfoundland and Labrador contributes only 1.4 per cent of Canada's total GHG emissions, the province accounts for 2.4 per cent of emissions related to fossil fuel industries and 3.6 per cent of emissions from mining and oil and gas extraction. The province's energy plan

26 The Alberta Innovates website has additional detail on the purpose, mandate, and programs in energy and environment: www.albertainnovates.ca/energy/introduction.

27 Environment Canada, *National Inventory Report 1990–2008*, Appendix A, 83.

28 Saskatchewan Environment, "Climate Change Research and Development Projects."

29 LiveSmart BC, "Progress and Timelines."

30 Spectra Energy, *Fuel for Thought*, 3–4.

calls for "investing revenues from non-renewable resources into developing a renewable resource economy powered by hydro, wind, and other green energy sources."[31] This strategy will not reduce emissions resulting from ongoing hydrocarbons development and production, but it may help reduce overall stationary energy emissions.

MANUFACTURING

Canada's manufacturing sector contributes 13 per cent of total stationary-energy-related GHG emissions and 6 per cent of total GHG emissions. Iron and steel, chemicals, pulp and paper, and cement are the key contributors. The long-term trend has been a gradual decline in emissions from this sector, from 55 Mt in 1990 to 43.4 Mt in 2008. The declining trend has been most evident in Quebec, where emissions dropped from 12.1 Mt in 1990 to 7.7 Mt in 2008. Geographically, Ontario, Quebec, Alberta, and British Columbia account for the largest shares. (See Chart 13.)

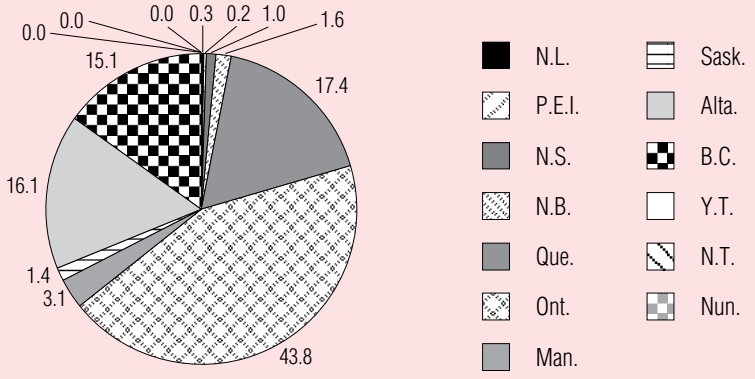
Ontario's climate action plan and *Green Energy Act* include provisions to encourage industrial sector energy efficiency, and to regulate industrial emissions.[32] However, the industrial regulation provisions have not yet been implemented. The objective is to ensure the continued competitiveness of Ontario's industry through regulations that are comparable to those in the United States and competitor jurisdictions.[33] Manufacturing firms in Ontario also have access to the Industrial Conservation Initiative, established to encourage energy conservation and efficiency, to the Innovation Demonstration Fund established to support innovative clean energy technology development, and to the Ontario Emerging Technologies Fund, a venture capital fund established to encourage clean technology.

The Technoclimat fund has been established to support technology innovation to reduce GHG emissions, and funds up to $3 million per project.

Quebec also has a climate action plan that includes industrial energy efficiency. Because fuel oil is still used in the industrial sector, incentives to stop using oil are part of the package, including financial aid to manufacturers.[34] The off-oil programs initiated in 2008 received a total of $165 million in funding.[35] The Technoclimat fund has been established to support technology innovation to reduce GHG emissions. This fund is one of the few in Canada that requires the applicant to quantify the anticipated GHG reductions. Technoclimat funds up to $3 million per project.[36]

Alberta and British Columbia have energy efficiency programs, technology investment funds (including venture capital access), and capital support programs for emissions-reducing investments, but they do not have incentives or programs specific to manufacturing. British Columbia has a carbon tax that applies to all fuel purchased by manufacturers, as well as small business tax credits to ensure

Chart 13
Manufacturing GHG Emissions, 2008
(per cent)



Sources: Environment Canada; The Conference Board of Canada.

31 Government of Newfoundland and Labrador, *Economic Self-Reliance and Environmental Sustainability*.

32 Ontario Ministry of the Environment, *Climate Change—Our Climate Change Action Plan*.

33 Ontario Ministry of the Environment, *Climate Change Action Plan 2008–2009 Annual Report*, 53.

34 Développement durable, Environnement et Parcs Québec, *2006–2012 Climate Change Action Plan*.

35 Développement durable, Environnement et Parcs Québec, *Troisième bilan de la mise en œuvre du plan d'action 2006–2012 sur les changements climatiques*, 6.

36 Agence de l'éfficacité énergétique Québec, "Technoclimat."

that the carbon tax is revenue neutral from the government's point of view. Legislation to cap and regulate emissions has been passed, but not brought into force, pending participation in an emissions trading system.

Overall, Canada's manufacturing sector has taken steps to reduce its GHG emissions and remain competitive with U.S. manufacturers and trading partners. The provincial action plans include a range of measures that affect or influence manufacturers, but they do not include many initiatives specific to that sector.

CONSTRUCTION, AGRICULTURE, AND FORESTRY

With emissions of only 3.4 million tonnes, construction, agriculture, and forestry contribute little to Canada's GHG emissions total. In part, this is because the emissions in this category are calculated from the stationary use of energy only. Just over 69 per cent of stationary-energy-related emissions in this category come from the agricultural sector. Non-energy emissions from agriculture are more substantial, but are included in a separate category. Emissions related to land use and land-use changes result from both agriculture and forestry, but are not included in this analysis.

Construction, agriculture, and forestry contribute little to Canada's GHG emissions total.

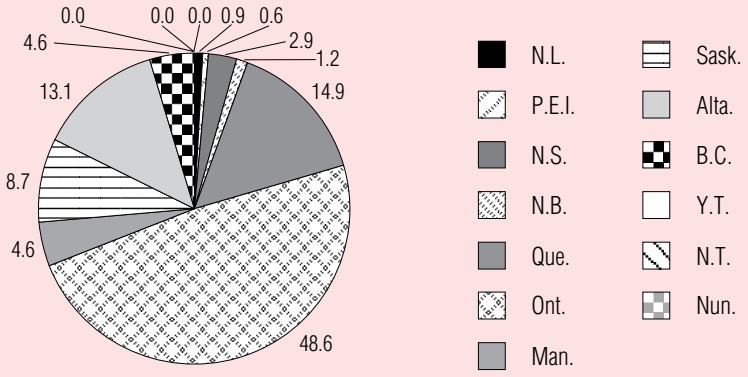
Ontario contributes almost half of the emissions in this category, primarily because of its larger population base, agricultural industry, and thriving construction sector. (See Chart 14.) Alberta's share reflects a strong agricultural sector and the impact of oil sands construction.

All provinces and territories except Prince Edward Island have established building efficiency standards. About half of the provinces and territories are updating their building codes to include measures to reduce emissions, and the rest are contemplating similar actions in the future. However, those measures address emissions related to the operating phase, rather than the construction phase. Specific measures that affect emissions from the construction process itself are difficult to find. Similarly, most of the action plan measures for forestry and agriculture relate to categories other than stationary energy emissions.

RESIDENTIAL, COMMERCIAL, AND INSTITUTIONAL

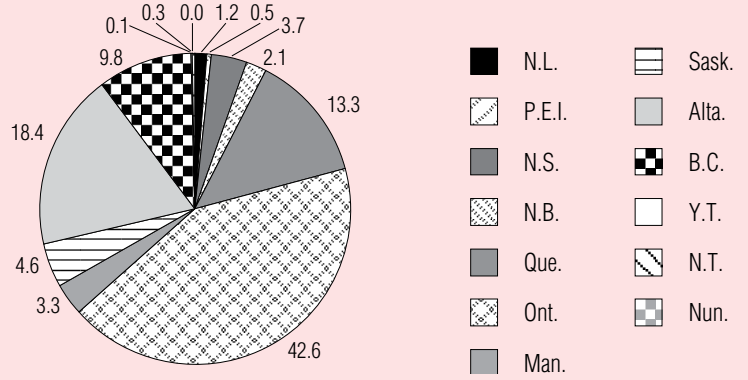
Each province has diverse initiatives and programs to help manage and reduce emissions from residential, commercial, and institutional buildings. Ontario, Alberta, Quebec, and British Columbia, with just under 86 per cent of Canada's population and just over 86 per cent of GDP, are responsible for 84 per cent of emissions in this category. Total Canadian GHG emissions in this category increased from 68.7 Mt in 1990 to 77.9 Mt in 2008 (0.7 per cent per year, or about the same rate as population growth), with the entire increase coming from the commercial and institutional category (1.7 per cent per year growth, just over half the rate of GDP growth). Residential emissions

Chart 14
Construction, Agriculture, and Forestry GHG Emissions, 2008
(per cent)



Sources: Environment Canada; The Conference Board of Canada.

Chart 15
Residential, Commercial, and Institutional GHG Emissions, 2008
(per cent)



Sources: Environment Canada; The Conference Board of Canada.

rose in the early 1990s, then declined slowly, suggesting that efficiency improvements in buildings, furnaces, water heaters, and other energy-burning appliances have offset population growth.

Government action plans include a broad range of measures to reduce GHG emissions from residential, commercial, and institutional use of energy. Some of the more common measures and their implementation across Canada are shown in Table 5. The table focuses on items that are specifically addressed or identified as priorities in the provincial climate action plans, updates, and related documents. In many cases, they may ignore actions being taken by Crown agents or Crown corporations. In addition, generous credit has been given in the table for actions that are only partly implemented or are at the planning stage.

Table 5
Provincial and Territorial Climate Initiatives in the Residential, Commercial, and Institutional Sectors

Measure	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nun.
Energy conservation plan or initiatives	√	√	√	√	√	√	√	√		√		√	
Building efficiency improvements—new buildings	√	√	√	√	√	√	√	√	√	√	√	√	
Building efficiency improvements—retrofits	√	√	√	√	√	√	√	√	√	√	√	√	
Increased reliance on renewable energy in buildings	√	√		√	√	√	√	√			√	√	
Low-income energy efficiency program	√			√			√	√					
Regulatory support for residential micro-generation	√					√			√				
Education programs aimed at conservation and efficiency	√	√	√	√	√	√	√	√	√	√	√	√	√
Financial support for energy audits	√		√	√		√	√	√			√	√	
Energy standards for new residential buildings	√	√	√	√	√	√	√	√	√	√			
Building code revisions to reduce emissions	√				√	√	√			√			
Energy efficiency standard for public buildings	√	√	√	√	√	√	√	√	√	√	√	√	
Low-emissions policy for government office equipment	√			√	√	√				√		√	
Government buildings retrofit program	√	√	√	√	√	√	√	√	√	√	√	√	
Climate change part of infrastructure funding decisions	√		√	√		√					√		
Energy efficiency promoted in public housing	√		√	√	√	√	√	√		√	√	√	
Minimum efficiency standards for appliances		√	√	√		√	√			√			
Climate change included in school curriculum			√	√		√	√				√	√	
Energy pricing used to encourage conservation			√	√		√							

√ = measure in place
Sources: provincial climate action plans; The Conference Board of Canada.

From the range of actions and the reasonably consistent adoption across the country, one might conclude that residential, commercial, and institutional buildings have been a key target in developing climate action plans. However, many of these initiatives represent low-hanging fruit. Measures such as energy efficiency, energy conservation, building retrofits, and appliance efficiency labels were initially developed in response to high energy prices and not climate change. In many cases, climate action plans have either co-opted or reinforced existing energy efficiency plans. This is not to criticize these initiatives, but simply to point out that they were among the most developed themes before climate action plans came into existence.

TRANSPORTATION

As discussed in Chapter 2, the transportation sector includes a broad range of transportation modes and objectives, as well as millions of emissions sources in the form of individual vehicles. In addition, consumer preferences have a direct impact on transportation emissions trends. Consequently, developing cost-efficient and effective regulations to reduce transportation-related GHG emissions is particularly challenging.

Provincial measures to date, as summarized in Table 6, have focused on fuel choices and vehicle choices, as well as education campaigns to encourage use of public transit, discourage vehicle idling, promote the purchase

Table 6
Provincial and Territorial Climate Initiatives in Transportation

Measure	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nun.	Canada
Technology R&D delivery	√					√		F	√			√		√
Technology R&D funding	√	F	√		√	√	√	F	√			√		√
Technology implementation funding	√	F	√	√	√	√	√	F	√			√		√
Renewable fuel standards—gasoline		F		F	√	√	√	√	√	F				√
Renewable fuel standards—diesel		F		F	√	?	√	√	√	√				√
Vehicle efficiency standards		F	√	F	√	F				√	F	F		F
Public transit plan and funding	F	F	F	√	√	√	√	√	F	√				
Vehicle rebates for low or zero emissions	F	√			√	√		√		√	F	√		√
Greening government fleet	√	√	√	√			√	√	√	√	F	√		
Public education campaigns	F	F	√	√	√	√	√	√	√	√	√	√		√
Support for municipalities	√		√	√	√	√	√	√	√	√	√	√		
Vehicle idling restrictions			Gov't	F		F				F	F	F		
Vehicle idling information campaigns	√		√	√	√	√		√	F	√	√	√		
Vehicle emissions standards			√	F		F	√			F	F			F

√ = measure in place
F = planned for the future
Gov't = measure applies to government only
Sources: provincial climate action plans; The Conference Board of Canada.

of low-emitting vehicles, etc. There have also been initiatives to improve urban planning to reduce traffic congestion and provide a broader range of pathways and alternatives to vehicle transport.

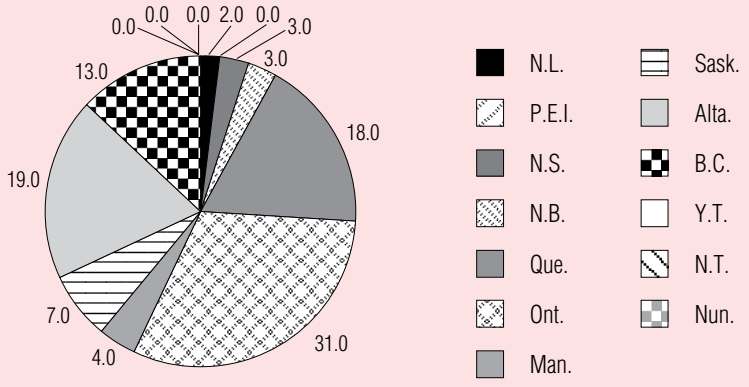
The provincial shares of transportation GHG emissions are shown in Chart 16. Ontario, Alberta, Quebec, and British Columbia accounted for 81 per cent of the national total in 2008, which aligns approximately with the 86 per cent of Canada's population and 87 per cent of GDP they contribute.

In Ontario, road transportation accounted for the largest increase in GHG emissions between 1990 and 2007.

ROAD TRANSPORT

Road transportation, both light- and heavy-duty vehicles, contributed 135 Mt (68 per cent) of the total 198 Mt of GHG emissions from the transportation sector in 2008 for Canada as a whole. This category includes both light- and heavy-duty vehicles, powered by gasoline or diesel, for transporting people or goods. Heavy-duty diesel vehicles account for about one-quarter of these emissions, primarily transporting freight. Light-duty vehicles represent the largest share of road transport emissions (63 per cent), and include private passenger vehicles, taxis, short-haul urban goods movement, corporate fleets, etc.

Chart 16
Transportation Emissions, 2008
(per cent)



Sources: Environment Canada; The Conference Board of Canada.

In Ontario, road transportation accounted for the largest increase in GHG emissions between 1990 and 2007,[37] making it a key focus for improvement. The provincial action plan includes $11.5 billion of investment in 52 public transit projects in the greater Toronto and Hamilton corridor.[38] A key element of the strategy is to improve public transit service and availability to encourage commuters to leave their cars at home. This will have the added benefit of reducing congestion-related GHG emissions. A regional transportation plan from Metrolinx, the agency created to improve the coordination and integration of all modes of transportation in the area, estimates that GHG emissions in Ontario will be reduced by between 3.3 and 3.7 Mt per year by 2031 as a result of its initiatives.[39] GO Transit, the region's transit service, is also purchasing more powerful and more fuel-efficient locomotives to provide more passenger-kilometres of service with lower emissions. Ontario's Green Commercial Vehicle Program provides funding for commercial fleet operators to purchase and install anti-idling controls on heavy-duty vehicles. Ontario also has rebate programs to encourage consumers to buy hybrid vehicles.

Quebec's road transport plan addresses vehicle emissions standards, renewable fuels content, improving access to public transit, improved vehicle efficiency (particularly for heavy-duty trucks), inter-modal transport, and promoting alternatives to vehicle transport.[40] Quebec has made speed-limiting devices mandatory on all heavy-duty trucks, and continues to work with the industry to improve the efficiency of the existing fleet and to encourage fuel-efficient new trucks. Most provinces are working with the trucking industry on initiatives such as speed-limiting devices, single wide tires, and trailer skirts to improve the fuel efficiency of existing transport trucks by as much as 50 per cent.

37 Ontario Ministry of the Environment, *Climate Change Action Plan 2008–2009 Annual Report*, 11.

38 Ontario Ministry of the Environment, *Climate Change—Our Climate Change Action Plan.*

39 Ontario Ministry of the Environment, *Climate Change Action Plan 2008–2009 Annual Report*, 32.

40 Développement durable, Environnement et Parcs Québec, *2006–2012 Climate Change Action Plan.*

Alberta has a renewable fuel mandate and is developing and implementing programs to encourage consumers to buy energy efficient vehicles. However, Alberta lags other provinces in targeting public transit. The provincial focus to date has been more on large emitters and on technology development.

Rail traffic was estimated to account for just under 1 per cent of Canada's total GHG emissions in 2008. The volume of GHGs emitted by railways has been a fairly steady 6 to 7 Mt per year since 1990.

Saskatchewan has a renewable transportation fuels standard and strongly supports biofuels development. The province also has an anti-idling campaign.[41] Consumers who purchase green vehicles are also eligible for insurance and registration rebates.[42]

The Government of Canada has released GHG emissions standards for new vehicles, beginning in the 2011 model year.[43] Under the new regulations, emissions per 2016 model year vehicles will be 25 per cent lower than they were in 2008 model year vehicles, with the total reduction in GHG emissions over the entire life cycle of vehicles produced between 2011 and 2016 estimated at 92 Mt.[44]

RAILWAYS, MARINE TRANSPORTATION, AND AVIATION

Rail traffic in Canada was estimated to account for just under 1 per cent of Canada's total GHG emissions in 2008. The volume of GHGs emitted by railways has been a fairly steady 6 to 7 Mt per year since 1990. Given the modest emissions and lack of growth in emissions, it is not surprising that the provincial climate action plans do not address this category directly, particularly for freight transportation. Programs to improve intermodal freight infrastructure in some provinces will influence railway-related emissions. However, most of the anticipated improvements will come from actions taken by the railway companies themselves. For passenger transport, rail systems are considered part of the solution to the extent that increased ridership takes people out of their cars.

Similarly, marine transportation contributes less than 1 per cent of Canada's total emissions, and provincial action plans do not target this industry in a significant way. Newfoundland and Labrador has committed to working with the federal government to improve vessel design and implement advanced technologies to boost fuel efficiency.[45] New Brunswick has taken action to modernize ferry engines and reduce fuel consumption.[46] Quebec sees increased marine transport of aluminum in particular as part of an intermodal path to reduced freight-related emissions,[47] but the action plan does not include measures to reduce marine freight emissions or emissions intensity.

GHG emissions from aviation are less than 1 per cent of Canada's total, although they have grown by 32 per cent between 1990 and 2008. The provincial action plans and related documents surveyed for this report did not indicate any specific initiatives targeting aviation-related emissions.

OTHER TRANSPORTATION

"Other transportation" includes two categories: off-road vehicles and pipelines. Off-road transportation, primarily diesel-powered heavy-duty vehicles used at industrial facilities, has been on a steady growth path since 1990. It accounted for 17 per cent of total transportation-related emissions in 2008. These emissions are not subject to specific programs or targets for reduction.

The pipeline sector experienced growth in emissions in the 1990s, but the trend has since declined such that 2008 emissions were only 9 per cent above 1990 levels

41 Saskatchewan Environment, "Anti-Idling Program."

42 Saskatchewan Environment, "Programs for Individuals and Homeowners/Residential Users."

43 Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations.

44 Environment Canada, *Canada and the United States Announce Common Standards*.

45 Government of Newfoundland and Labrador, *Climate Action Plan 2005*, action 31.

46 Government of New Brunswick, *N.B. Climate Action Fund Investments*.

47 Développement durable, Environnement et Parcs Québec, *Troisième bilan de la mise en œuvre du plan d'action 2006–2012 sur les changements climatiques*, 10.

and accounted for only 3.8 per cent of total transportation GHG emissions. Pipeline companies are regulated with regard to fugitive emissions and have been working to reduce fuel requirements, something that also reduces GHG emissions, but provincial GHG action plans do not address them directly.

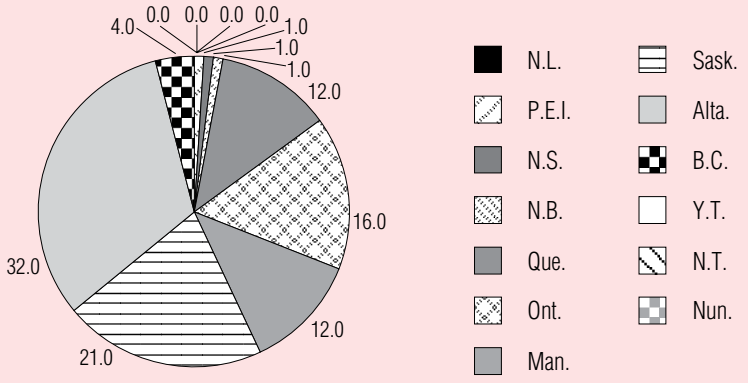
Quebec's climate change action plan includes a plan to negotiate GHG reduction agreements industry by industry.

INDUSTRIAL PROCESSES

Industrial process emissions related to minerals production, chemicals production, and metals production account for 7 per cent of Canada's total GHG emissions. The vast majority of these emissions occur in Ontario, Quebec, Alberta, and British Columbia.

Quebec's climate action plan does not target industrial processes with specific measures, but it does include a plan to negotiate GHG reduction agreements industry by industry. Quebec has negotiated an agreement with aluminum producers to reduce GHG emissions by 150,000 tonnes between 2008 and 2012.[48]

Chart 17
Agriculture Emissions, 2008
(per cent)



Sources: Environment Canada; The Conference Board of Canada.

48 Développement durable, Environnement et Parcs Québec, *Troisième bilan de la mise en œuvre du plan d'action 2006–2012 sur les changements climatiques*, 14.

Ontario's climate change action plan references industrial emissions, but does not include specific reduction targets or measures.[49] British Columbia does not address this category of emissions directly, and Alberta's actions would only directly affect these industries if emissions from individual establishments were large enough to be regulated under the Specific Gas Emitters Regulation.

AGRICULTURE

The agricultural sector has shown a steady upward trend in GHG emissions and accounts for 8.5 per cent of Canada's total emissions. As shown in Chart 17, Alberta, Saskatchewan, and Ontario are the three largest provincial contributors, with Quebec and Manitoba also showing large agricultural emissions.

The agriculture sector has shown a steady upward trend in GHG emissions.

Ontario's climate action plan includes subsidies for farmers to help them develop environmental risk management plans (including for GHGs) and measures to support biomass as an energy source.[50] In 2008, Quebec established a program to reduce emissions related to manure management.[51]

WASTE MANAGEMENT

Emissions from waste management arise primarily from solid waste disposal and waste-water processing, including sewage. The category accounts for only 3 per cent of Canada's total GHG emissions. The provincial allocation is shown in Chart 18. Notwithstanding the minimal contribution that waste management makes to Canada's GHG emissions, most provinces have taken action to reduce the impact. Ontario's action plan includes a target

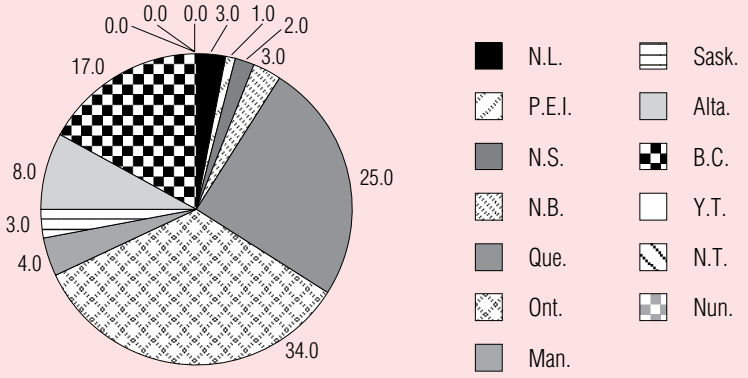
49 Ontario Ministry of the Environment, *Climate Change Action Plan 2008–2009 Annual Report*, 11.

50 Ibid., 66, 69.

51 Développement durable, Environnement et Parcs Québec. *2006–2012 Climate Change Action Plan*, action item 15.

of diverting as much as 70 per cent of landfill waste to recycling programs by 2011.[52] The province also has recycling programs for used tires and electrical equipment, as well as landfill methane capture regulations.[53] Quebec regulates fugitive emissions from landfills and has regulations that require capture and flaring.[54] Similarly, Saskatchewan's Go Green program includes recycling of tires, used oil, electronic waste, and household hazardous materials. Alberta stands alone as a major source of waste management emissions that has not announced specific reduction measures as part of its climate action plan. At the other end, Nova Scotia is the only province that has announced actions toward reducing emissions resulting from water management and waste-water treatment.

Chart 18
Waste Management Emissions, 2008
(per cent)



Sources: Environment Canada; The Conference Board of Canada.

52 Ontario Ministry of the Environment, *Climate Change Action Plan 2008–2009 Annual Report*, 16.

53 Ontario Ministry of the Environment, *Landfill Gas Collection Now Mandatory.*

54 Développement durable, Environnement et Parcs Québec. *2006–2012 Climate Change Action Plan.*

CHAPTER 4

Are We Making Progress?

Chapter Summary

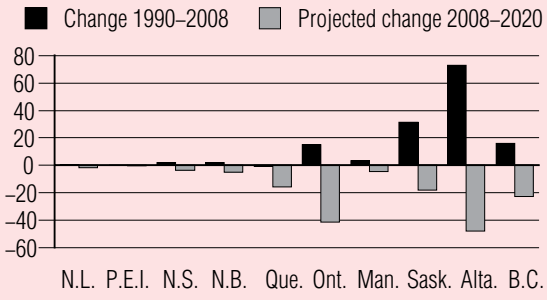
- There has been little progress to date toward achieving provincial emissions targets. All provinces have aggressive targets that will require accelerated efforts if they are to be met.
- Alberta, Saskatchewan, and to a lesser extent British Columbia face challenges in reducing emissions from energy production. Ontario, Quebec, and British Columbia face challenges related to transportation emissions. All provinces face a need to reduce energy consumption in buildings, freight transportation, and passenger transportation.
- Most of the provincial climate action plans and progress reports fail to provide a clear articulation of the progress made to date, or the impact of future action items in reducing emissions.

The previous chapters have reviewed the sources and levels of GHG emissions by major category, the level of emissions by province, and the climate action plans and policy measures in place in each province to reduce emissions. This chapter provides an analysis of the progress to date and of the remaining reductions that are planned. The provincial action plans do not always identify the anticipated GHG reductions from each measure implemented, nor do they quantify their collective impact. The analysis in this chapter is therefore qualitative in nature.

Provincial emissions reduction performance and targets for 2020 are shown in Chart 19. In cases where provinces do not have specific targets for 2020, the value shown in the chart is interpolated. As the chart indicates, all provinces are projecting a paradigm shift to emissions reductions before the end of this decade. This anticipated shift is based on provincial action plans and is subject to uncertainty.

Chart 19 clearly shows that all provinces face a significant challenge. There has been very little progress to date in reducing GHG emissions, and any progress that has been made has occurred fairly recently. The momentum

Chart 19
Provincial GHG Emissions Reduction Targets
(million tonnes per year)



Source: The Conference Board of Canada.

must be sustained and increased. Table 7 details the emissions increases since 1990 by province and by emissions category.

Federal initiatives in three main areas will contribute to emissions reduction: coal-fired power generation, light-duty vehicle emissions, and heavy-duty vehicle emissions.

Table 7
Provincial GHG Emissions and Changes Since 1990

	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Emissions in 2008 (million tonnes)										
Stationary energy	4,580	3.76	14,200	11,600	23,200	87,200	4,780	28,900	136,000	23,500
Transport	4,020	6.04	5,370	4,880	35,800	62,000	7,310	14,100	37,200	25,500
Fugitive sources	678	0.00	76	31	510	1,850	696	16,600	36,000	6,200
Agriculture	68	3.30	410	450	7,800	10,000	7,600	13,000	20,000	2,400
Waste disposal	650	0.86	450	637	5,400	7,400	860	650	1,700	3,800
Other	98	0.20	415	364	9,357	21,430	656	1,650	13,436	3,603
Total	10,094	14.15	20,921	17,963	82,067	189,880	21,902	74,900	244,336	65,003
Share of provincial emissions in 2008 (per cent)										
Stationary energy	45.4	26.6	67.9	64.6	28.3	45.9	21.8	38.6	55.7	36.2
Transport	39.8	42.7	25.7	27.2	43.6	32.7	33.4	18.8	15.2	39.2
Fugitive sources	6.7	0.0	0.4	0.2	0.6	1.0	3.2	22.2	14.7	9.5
Agriculture	0.7	23.3	2.0	2.5	9.5	5.3	34.7	17.4	8.2	3.7
Waste disposal	6.4	6.1	2.2	3.5	6.6	3.9	3.9	0.9	0.7	5.8
Other	1.0	1.4	2.0	2.0	11.4	11.3	3.0	2.2	5.5	5.5
Increase in emissions since 1990 (million tonnes)										
Stationary energy	–810	–2	2,900	900	–6,300	3,700	–40	9,600	39,500	4,700
Transport	390	1	390	900	8,000	14,900	320	4,910	15,200	7,100
Fugitive sources	678	0	–1,094	30	229	510	275	10,540	6,900	2,880
Agriculture	20	0	–60	–10	900	–1,000	2,300	4,900	6,000	200
Waste disposal	80	0	–300	–13	200	1,600	260	150	400	400
Other	19	0	130	197	–3,687	–6,035	136	1,347	5,070	422
Total	377	–1	1,966	2,003	–658	13,675	3,251	31,447	73,070	15,702
Per cent increase since 1990										
Stationary energy	–15.0	–33.3	25.7	8.4	–21.4	4.4	–0.8	49.7	40.9	25.0
Transport	10.7	13.8	7.8	22.6	28.8	31.6	4.6	53.4	69.1	38.6
Fugitive sources	0.0	0.0	–93.5	2,030.1	81.5	38.1	65.3	173.9	23.7	86.7
Agriculture	41.7	–8.7	–12.8	–2.2	13.0	–9.1	43.4	60.5	42.9	9.1
Waste disposal	14.0	27.2	–40.0	–2.0	3.8	27.6	43.3	30.0	30.8	11.8
Other	23.6	517.9	45.4	117.3	–28.3	–22.0	26.2	443.8	60.6	13.3
Total	3.9	–7.3	10.4	12.6	–0.8	7.8	17.4	72.4	42.7	31.8

Sources: Environment Canada; The Conference Board of Canada.

FEDERAL REGULATION OF COAL-FIRED POWER GENERATION EMISSIONS

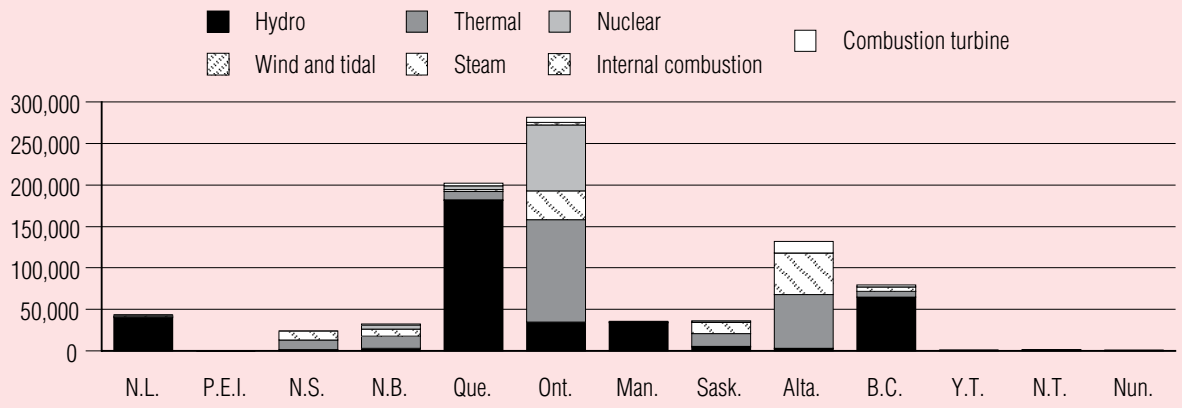
In June 2010, the federal government announced plans to regulate electricity-sector emissions from the generation of electricity from coal. Electricity generation in Canada contributed 17 per cent of total GHG emissions in 2008, with coal-fired power generation accounting for 13 per cent (or about three-fourths of electricity-sector emissions), even though coal accounts for only 19 per cent of total power generated in Canada.[1] Action on emissions from coal-fired generation could contribute significantly to reducing emissions from the sector.

Although the proposed federal regulations have not yet been published, the announcement contained a broad description. The press release indicated that all new coal-fired generation units plus any that come to the end of their economic life would be required to reduce their emissions intensity to the level achieved by combined-cycle natural-gas-fired units. The regulations would be phased in beginning in 2015, and by 2025 would reduce GHG emissions by 15 Mt per year[2] (13 per cent of the sector's 2008 GHG emissions). The proposed regulations would have significant regional impacts given that coal-fired generation capacity is unevenly distributed between provinces. Chart 20 shows electricity generation by province and by generation technology. The portion shown as steam generation is dominated by coal-fired stations.

Ontario will probably not be affected as its current plan is to phase out coal-fired generation entirely by 2014. If its target is met, Ontario will be off coal before the proposed regulations take effect.

As shown in Chart 20, the proposed regulations are likely to affect electricity generation in Alberta, Saskatchewan, Nova Scotia, and New Brunswick the most, and have no impact in British Columbia, Manitoba, Quebec, or the northern territories. Ontario will probably not be affected given that its current plan is to phase out coal-fired generation entirely by 2014. Assuming that the target is met, Ontario will be off coal before the proposed regulations take effect. The precise impact on the four provinces that rely significantly on coal generation will depend on the age of existing plants, the ability to retrofit with carbon capture and storage technologies, and the need to extend the life of existing stations and build new stations.

Chart 20
Electricity Generation by Province and Technology, 2007
(GWh)



Source: Statistics Canada.

1 Environment Canada, *Backgrounder—Canada's Electricity Story*.

2 Ibid.

FEDERAL REGULATION OF LIGHT-DUTY VEHICLE EMISSIONS

The federal government recently released the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations that apply to vehicles for the 2011–2016 model years. It will also examine the potential for tighter restrictions in 2017 and beyond. The regulations are expected to reduce emissions per vehicle by 25 per cent as compared with 2008 model year vehicles. The regulations will result in an estimated average annual incremental reduction of 15.3 Mt of CO2e, for a cumulative reduction of 92 Mt "over the lifetime operation of all 2011 to 2016 model year vehicles sold in Canada."[3] In 2008, light-duty on-road vehicles accounted for 44 per cent of total transportation emissions. In the longer term, a 25 per cent reduction in light-duty vehicle emissions relative to 2008 could result in an annual emissions reduction of 22 Mt or more. The actual reduction would depend on growth in the vehicle stock, growth in kilometres travelled, and the mix of older vehicles that stay on the road after the new standards take effect.

FEDERAL REGULATION OF HEAVY-DUTY VEHICLE EMISSIONS

The federal government has also announced intentions to develop regulations governing emissions from heavy-duty vehicles.[4] A consultation document has been prepared to receive stakeholder inputs. The regulations will apply to all manufacturers or importers of heavy-duty engines and vehicles, but not to vehicle owners or operators. The regulations will apply to all on-road vehicles with a gross vehicle weight rating of more than 3,856 kilograms.[5] They will relate to total vehicle emissions, meaning that they will capture the combined impacts of engine performance, aerodynamics, tires, etc. Given that the standards will be applied at the point of production or import, modifications to the vehicle after the initial sale will not be incorporated.

3 "Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations."

4 Environment Canada, *Government of Canada to Regulate Emissions From Electricity Sector.*

5 Ibid., 1.

PROVINCIAL PROGRESS IN REDUCING GHGS

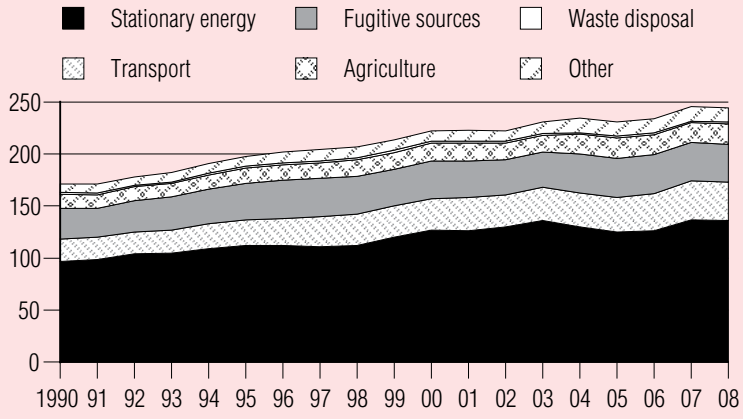
The rest of this chapter provides an assessment of the progress made in each province toward reducing GHG emissions, as well as a qualitative examination of the alignment between action plan measures and major sources of emissions. The territories are not included because their action plans encompass only government operations and do not apply to the entire territory. The territorial action plans are also much less detailed than provincial plans. The provinces are listed in order of emissions, from highest to lowest (in 2008).

Although Alberta had Canada's highest per capita GDP, the province accounted for only 11 per cent of population, indicating that emissions per capita and per dollar of GDP were well above the national average.

ALBERTA

In 2008, Alberta emitted 244 Mt of GHGs, which accounted for one-third of Canada's total emissions. Although Alberta had Canada's highest per capita GDP, the province accounted for only 11 per cent of population, indicating that emissions per capita and per dollar of GDP were well above the national average. Alberta's GHG emissions by category since 1990 are shown in Chart 21.

Chart 21
Alberta's GHG Emissions by Category
(million tonnes carbon dioxide equivalent)



Sources: Environment Canada; The Conference Board of Canada.

Alberta's total GHG emissions have risen by 43 per cent since 1990, while GDP has increased by 88 per cent, indicating that the emissions intensity of Alberta's economy has decreased significantly. All categories of emissions have grown by at least 23 per cent since 1990, with transportation showing the greatest percentage increase (60 per cent). From the point of view of both overall emissions and their growth since 1990, stationary energy and transportation should be the two highest priority sectors for emissions reductions. Within the stationary energy category, electricity and heat generation has accounted for the largest increase since 1990, at 39.5 Mt of the 61 Mt increase in stationary energy emissions. Oil and gas extraction plus mining plus fugitive emissions place second, with an increase of 30.1 Mt.

The growth in electricity emissions has been more moderate since 2000 than it was previously, reflecting the increasing role of natural gas, wind, and biomass in the province's generation mix. Clean coal technology and carbon capture and storage are central to the sector's and the province's focus moving forward. Improving energy efficiency is another key objective that contributes to de-linking emissions and economic growth.

In the oil and gas sector, Alberta's challenge has been that the growth in emissions due to rising production, particularly for oil sands, has had a much stronger impact than the declining emissions intensity per unit of production. This trend is not expected to continue through 2020, given that oil sands production is expected to peak mid-decade. Beyond that period, there is potential that declining intensity could more than offset production growth, with total emissions showing a flat or declining trend, albeit from a much higher level. Natural gas processing is also a key contributor to GHG emissions from the oil and gas sector, primarily from processing facilities and also from field operations. Carbon dioxide, a common component of raw natural gas, must be removed prior to long-distance transport. Natural gas processing plants contribute almost all of Alberta's 26 Mt of fugitive GHG emissions (6.9 Mt of growth since 1990). Given that natural gas production in Alberta is no longer increasing, this source of emissions can be expected to stabilize. If CCS technology becomes broadly available, there is also potential for it to be applied to natural gas processing plants.

Alberta's GHG reduction strategy identifies volumetric targets for 2050, but does not provide details for 2020. By 2050, Alberta expects to achieve a 24 Mt reduction through energy efficiency, a further 139 Mt reduction through CCS implementation, and a 37 MT reduction from greening energy production.

The two most significant questions relate to the timing of commercial success for CCS technology and the timing for reductions in the level of GHG emissions.

Although the available information does not permit a quantitative assessment of Alberta's progress toward the long-term target, there is a clear alignment between the key focal points of the strategy and the historical emissions path. Almost 86 per cent of Alberta's emissions come from stationary energy sources—primarily oil and gas extraction and processing and electricity production. The targets to reduce emissions through CCS and greening energy production account for 88 per cent of the total targeted reduction. The two most significant questions relate to the timing of commercial success for CCS technology and the timing for reductions in the level of GHG emissions. The pending federal regulations for coal-fired electricity generation may provide new incentives and accelerated timing for reducing emissions related to power generation.

Alberta's transportation sector also faces a significant challenge in reversing the historical trend to increasing emissions. Since 1990, transportation-related emissions have increased from 22 Mt to 37.2 Mt, an increase of 70 per cent, with half of the increase related to road transport and most of the rest related to off-road vehicles (primarily heavy-duty vehicles used at industrial facilities). Although Alberta is introducing programs that will influence vehicle choices, encourage purchase of low-emitting vehicles, and perhaps influence consumer behaviour, these programs have not been as strong a focus in Alberta as in other provinces. The combined effect of federal regulations and Alberta's emerging programs will need to be monitored to ensure that emissions reductions in this sector are made and contribute their share to overall reductions.

Finally, emissions related to Alberta's agriculture industry increased from 14 Mt in 1990 to 20 Mt in 2008. This sector is currently a source of emissions offsets under Alberta's GHG regulations. It is unclear what contribution agriculture will make to GHG emissions reductions beyond the offsets being offered to other regulated emitters.

ONTARIO

Ontario is Canada's second largest source of emissions in Canada. The historical trend of emissions is shown in Chart 22. Stationary energy contributes less than half of current emissions (46 per cent in 2008), a much lower share than in Alberta. Ontario has very limited oil- and gas-related emissions, which are almost all a result of processing industries rather than extraction. Ontario also produces half of its electricity from nuclear power and is working to reduce coal-fired generation and resulting emissions to zero by the end of 2014. The rising trend from 1997 to 2003 in stationary energy emissions was primarily driven by increased use of coal units while nuclear plants were being refurbished. Additional nuclear units will require refurbishment over the coming decade, although if the coal units are all retired as planned, the increase in emissions as nuclear units are refurbished will likely be much smaller.

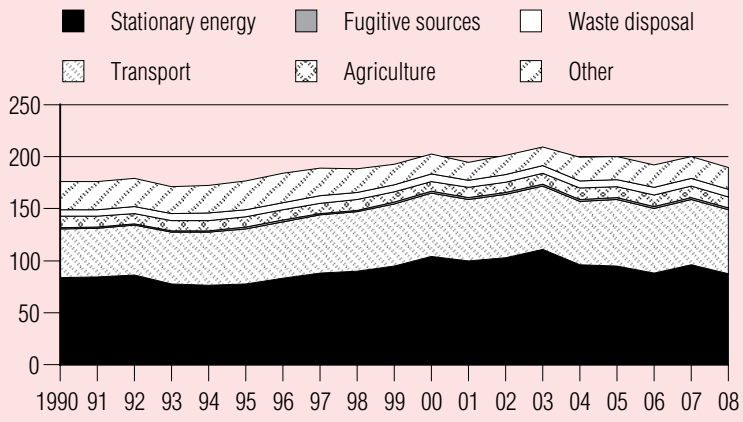
It is not clear how the current programs and action items will act quickly enough and have enough impact to contribute significantly to Ontario's 2020 goal.

Ontario has long been a leader in Canada in implementing energy conservation programs, particularly electricity conservation. However, residential emissions have increased by more than 17 per cent since 1990, and commercial emissions by 45 per cent. Given the slow turnover of energy-using capital stock (primarily buildings, lighting, and furnaces), this represents a significant challenge. Even with the strong focus in Ontario's action plan on energy efficiency, past measures have not reduced the level of GHG emissions, and current or near-term actions may not show significant results for some time to come. Residential and commercial emissions account for 38 per cent of total GHG emissions from stationary energy applications. It is not clear how the current programs and action items will act quickly enough and have a large enough impact to contribute significantly to Ontario's 2020 goal.

Transportation is Ontario's second largest contributor of GHG emissions, rising from 47.1 Mt in 1990 to 62 Mt in 2008. The growth has been dominated by road transport, although off-road heavy-duty vehicle emissions have increased significantly since 2004 (most likely as a result of data revisions). Ontario's transportation emissions have been fairly stable since 2000, suggesting that the programs in place have improved the emissions intensity of transportation. The challenge looking forward is to break the links between population, vehicle stock, GDP, tonnage transported, and the resulting emissions—that is, that as the province grows, the resulting emissions do not increase as well. The combination of federal regulation, provincial programs, and industry initiatives may or may not be sufficient to ensure that the 2020 target is met.

Ontario's manufacturing sector has reduced GHG emissions from 22.6 Mt in 1990 to 19 Mt in 2008 and has therefore contributed to the solution. Similarly, industrial process emissions have fallen from 27.4 Mt in 1990 to 21.3 Mt in 2008. These sectors are not, and do not need to be, significant areas of focus in Ontario's action plan. The agricultural sector's emissions have been fairly constant over the period and contribute only 5 per cent to the province's total.

Chart 22
Ontario's GHG Emissions by Category
(million tonnes carbon dioxide equivalent)



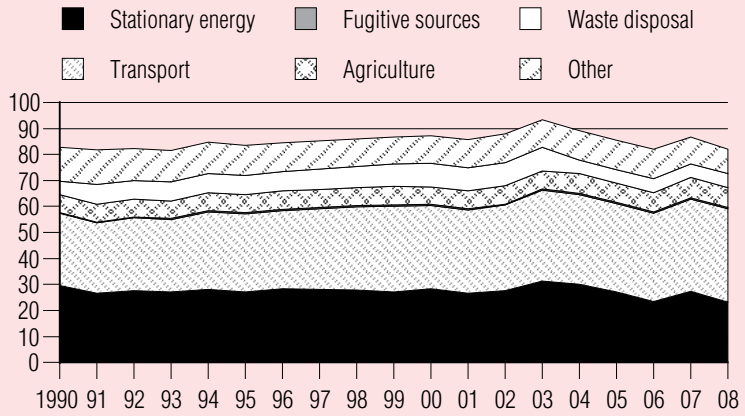
Sources: Environment Canada; The Conference Board of Canada.

QUEBEC

Quebec is Canada's third largest source of GHG emissions primarily because of its population, but also because of its industrial base. Chart 23 shows the emissions trend by category since 1990.

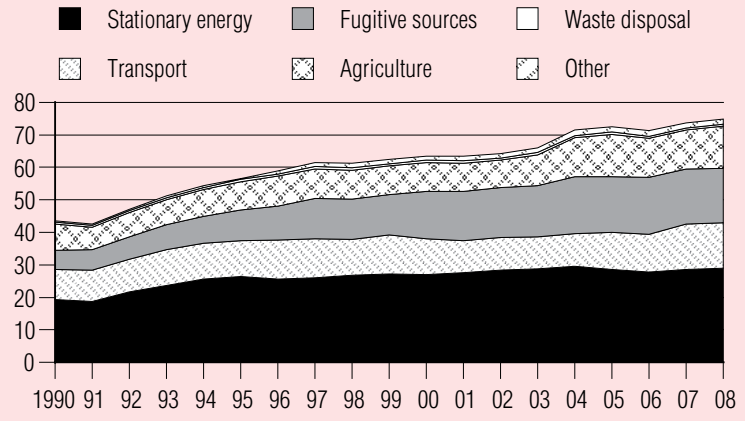
Of the three largest-emitting provinces, Quebec shows by far the best performance, with total emissions in 2008 almost identical to the 1990 level. The declining trend in stationary energy emissions has resulted primarily from manufacturing and residential emissions falling faster than commercial sector emissions have increased. The residential sector performance cannot be attributed to the climate action plan measures, since it represents a long-term trend that predates the action plan. However, the action plan's focus on buildings, energy efficiency, and energy conservation is in line with the trend. The commercial sector's performance is less impressive, although progress is being made. Quebec has also made progress in reducing stationary energy emissions from manufacturing, construction, and forestry.

Chart 23
Quebec's GHG Emissions by Category
(million tonnes carbon dioxide equivalent)



Sources: Environment Canada; The Conference Board of Canada.

Chart 24
Saskatchewan's GHG Emissions by Category
(million tonnes carbon dioxide equivalent)



Sources: Environment Canada; The Conference Board of Canada.

Of the three largest-emitting provinces, Quebec shows by far the best performance.

With its very high reliance on hydro generation, emissions from electricity and heat production are negligible. The transport sector, on the other hand, is a major contributor, at almost 44 per cent of total GHG emissions. Heavy-duty vehicles account for only 30 per cent of road transport emissions, suggesting that light-duty passenger vehicles are a more important area of focus. Quebec's climate action plan includes speed-limiting devices and other measures to reduce emissions from heavy-duty vehicles. It also includes incentives for efficient passenger vehicles, as well as a range of initiatives to encourage public transit and alternatives to vehicle transport. These programs align well with the direction of change that will be required to meet the province's GHG reduction goals, although the actual contribution they will make remains uncertain.

SASKATCHEWAN

Saskatchewan ranks fourth in GHG emissions in Canada despite its small population base. This is primarily because of emissions from stationary energy (power generation and oil and gas extraction) and emissions from agriculture. (See Chart 24 for emissions by category.)

Stationary energy-related emissions in Saskatchewan come primarily from electricity generation (15.4 Mt in 2008) and oil- and gas-related activities (8.9 Mt in 2008). Fugitive emissions are also primarily from oil and gas production and have almost tripled since 1990, in line with growing natural gas production. Together, stationary energy and fugitive emissions account for 51 per cent

of Saskatchewan's total. Power generation (primarily coal-fired, with some natural gas) accounts for about one-third of stationary energy plus fugitive emissions in the province. SaskPower is working to reduce emissions from power generation, and may be affected by federal regulations. Some additional progress will likely be required to reduce emissions significantly below the current level. Current initiatives related to clean coal technology implementation, CCS, and large-emitter regulation will provide additional impetus, although the end result is not yet known.

The oil and gas sector represents a significant challenge for Saskatchewan. On the positive side, the province is home to an operating CCS project, and natural gas processing plants provide a relatively simple carbon capture opportunity (particularly as compared with coal-fired power generation). Field operations might present a larger challenge, although the industry has demonstrated significant progress through time. The challenge will be to reduce intensity faster than output grows so that total emissions fall in the future. Saskatchewan's climate action plan includes measures to reduce oil- and gas-related emissions, although additional initiatives will likely be required.

Saskatchewan has an opportunity to take a leadership position in Canada.

The transportation sector accounts for a small share of total emissions relative to other provinces, although the level of emissions has grown by more than 50 per cent since 1990. It is not clear that the combination of the provincial Go Green initiatives and federal regulations will result in significant near-term emissions reductions. Additional measures may be required.

The agricultural sector in Saskatchewan is important to address both because of its large share of provincial emissions (17 per cent) and because of its large share of national agricultural emissions. Saskatchewan has an opportunity to take a leadership position in Canada by preparing an action plan that protects farm incomes while reducing GHG emissions. This is an area that needs further attention.

BRITISH COLUMBIA

Most of the increase in GHG emissions in British Columbia since 1990 occurred prior to 2000. (See Chart 25.) Provincial emissions come primarily from transportation (39 per cent) and stationary energy (36 per cent), with other categories contributing much smaller shares. Total emissions in 2008 were 65 Mt, which is modest in comparison with both population and GDP. However, there is a need to ensure some key focus areas align with the province's action plan.

Because British Columbia has fewer and larger natural gas plants than Alberta and Saskatchewan, the province has better opportunities to capture large volumes of carbon dioxide from a single location.

British Columbia depends almost entirely on hydro power for electricity. The moderate climate in the greater Vancouver region, where much of the population lives, also helps limit emissions related to residential and commercial buildings. The residential sector has not been a source of emissions growth, although it has not been a source of reductions either. The focus on building efficiency and energy conservation in British Columbia's action plan should eventually help reduce residential emissions. The commercial sector has shown an increasing trend (most likely related to growing floor space) that may not be fully addressed by the action plan.

The oil and gas sector, including fugitive emissions, has not accounted for a large share of total emissions, but it has contributed to a significant share of emissions growth. This is once again related to growth in natural gas production, with the associated carbon dioxide removal and venting at processing plants. Provincial targets to reduce field emissions from flaring and venting will reduce emissions intensity as they come into force. Spectra Energy is also looking at CCS for one of its larger natural gas processing plants. If implemented, this will significantly reduce fugitive emissions. British Columbia has an advantage over both Alberta and Saskatchewan in this regard because its natural gas plants are fewer in number and larger in scale, providing better opportunities to capture large volumes of carbon dioxide from a single location. However, the recent growth in natural

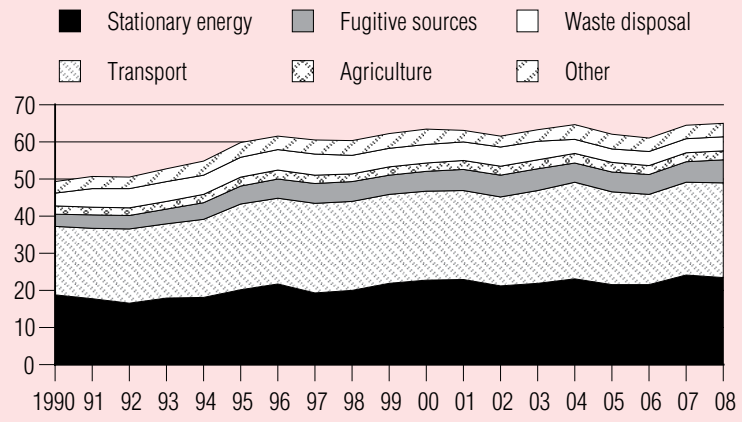
gas production in northeast British Columbia (shale gas and tight formation gas) raises the question of whether production growth will outstrip reductions in emissions intensity.

British Columbia's transportation sector follows a familiar pattern to other provinces. The shift from light-duty gasoline cars to trucks and minivans, together with increasing vehicle use, has contributed to strong growth in emissions from light-duty vehicles. Heavy-duty diesel vehicles have also contributed to the total increase of 39 per cent in transportation emissions since 2008. Again, similar to other provinces, it is not clear that climate initiatives in place and proposed federal regulations will combine to achieve reductions in the level of transportation emissions over the time frame projected.

MANITOBA

Manitoba's combination of a modest population base, complete reliance on hydro electricity, and limited manufacturing and heavy industry means that its GHG emissions are small. More than half of emissions related to stationary energy come from residential and commercial sectors. Manitoba is a leader in energy conservation and alternative energy for buildings. Its climate action plan has a strong focus on continued improvement in this area. Although the results may take time to be realized as the capital stock is replaced or updated, they are likely to be achieved.

Chart 25
British Columbia's GHG Emissions by Category
(million tonnes carbon dioxide equivalent)



Sources: Environment Canada; The Conference Board of Canada.

Agriculture is one area where Manitoba's climate action plan may need additional programs and initiatives to achieve significant emissions reductions. This sector accounts for more than one-third of total emissions in Manitoba. The targeted reduction of 250,000 tonnes of carbon dioxide equivalent (CO_2e) emissions from 2008 to 2012 is only a small fraction (3 per cent) of the 7.6 million tonnes emitted by the sector in 2008.

Manitoba is a leader in energy conservation and alternative energy for buildings, and has a strong focus on continued improvement in this area.

NOVA SCOTIA

Stationary energy accounts for two-thirds of Nova Scotia's total GHG emissions, and electricity generation accounts for two-thirds of stationary-energy-related emissions. Appropriately, the Greenhouse Gas Emissions Regulation passed in 2009 addresses emissions from electricity production, placing a cap on total emissions from this sector that is intended to result in emissions in 2020 that are 10 per cent below the 1990 baseline. Nova Scotia's action plan also addresses energy consumption in residential and commercial buildings, the second largest source of stationary-energy-related emissions. Given the long-term nature of the capital stock, the net impact of improvements in buildings is difficult to predict. Nova Scotia also has a hydrocarbons production sector. Although increased use of natural gas in place of coal and oil products is expected to reduce emissions, the climate action plan does not include measures specific to hydrocarbons production.

Nova Scotia's climate action plan includes several initiatives that target the transportation sector, which currently accounts for just over 25 per cent of total emissions. Light-duty vehicles, both gasoline and diesel powered, account for about half of transport emissions and are the primary focus of action plan measures.

NEW BRUNSWICK

Stationary energy accounts for 64 per cent of New Brunswick's GHG emissions, with electricity production contributing 59 per cent of stationary energy emissions and fossil fuel industries an additional 21 per cent. The

province has sector-specific reduction targets with supporting programs and incentives that target renewable electricity, electricity conservation, energy efficiency, public transport, and more efficient vehicles. The province anticipates a reduction of 5.5 Mt in 2012 relative to 2007 emissions (a reduction of 29 per cent). The most recent update was published in September 2009, but only partially quantified progress against reduction targets.[6]

The Lower Churchill hydroelectricity site would reduce provincial GHG emissions by just over 10 per cent.

NEWFOUNDLAND AND LABRADOR

Newfoundland and Labrador contributes only 10 Mt of GHG emissions annually, with 46 per cent from stationary energy and 40 per cent from transportation. Emissions in 2008 were only 7 per cent higher than in 1990. The oil and gas sector contributes significantly to stationary energy emissions, primarily through offshore operations such as Hibernia. Development of the Lower Churchill hydroelectricity site is planned and, once implemented, would reduce provincial GHG emissions by just over 10 per cent. The province's energy plan includes using a portion of the revenues from non-renewable resources to develop renewable and environmentally friendly energy sources. The climate action plan includes initiatives for building efficiency and energy conservation, as well as transportation initiatives such as idle-free zones, public transit, and communication programs.

6 New Brunswick Department of Environment, *Climate Change Action Plan, 2008–2009 Progress Report.*

PRINCE EDWARD ISLAND

Prince Edward Island produces the lowest total emissions (2 Mt per year) and second lowest per capita emissions among the provinces. Stationary energy accounts for 70 per cent of total emissions, with 38 per cent of stationary energy emissions from electricity generation. Transportation is the second largest emissions category. The provincial climate action plan relies heavily on replacing thermal generation with wind power, although there is work to be done to identify the storage technology that can match intermittent wind power with electricity demands at an acceptable cost. For transportation, the action plan includes a range of measures: promoting efficient vehicles, expanding public transit, bicycle paths, ethanol, etc. The energy efficiency of buildings is also a focus.

THE REMAINING GAP

Drawing conclusions based on the analysis in this chapter is a challenging task. Although it is clear that almost all provinces have developed emissions reduction initiatives that align with their primary sources of emissions, not much more can be said about the remaining gap. This is because the action plans contain very few emissions reduction targets linked to specific action plan initiatives. The regular updates are incomplete in terms of measuring the impacts of those initiatives that have been implemented.

CHAPTER 5

Conclusion

Chapter Summary

- More needs to be done to stop Canada's GHG emissions from increasing and ensure a future where emissions targets are being met. We do not appear to be fully on that path just yet.
- Regionally focused provincial action plans could benefit from improved coordination between jurisdictions. This could help effectiveness and efficiency.
- Examining and tackling climate action items as a whole, rather than just individually, would provide greater confidence that the targets can be met. Effectively communicating the results of that analysis would help Canadians understand the priorities.

The Canadian federal government has committed to reducing annual GHG emissions in Canada by 17 per cent by 2020, from 2005 levels. A handful of national strategies have been introduced to achieve this target, but there is also an assumption that provincial and territorial governments, with their individual climate action plans, will make a significant contribution to the national target.

However, this course of action has fallen well short of putting Canada on track to achieve its emissions reduction goals. GHG emissions in Canada have risen substantially over the past two decades. Emissions appear to have stabilized—and have even started to decline in some cases—since 2004, in part because of provincial emissions mitigation strategies implemented over the last decade, but clearly, more needs to be done.

Coordination would provide opportunities for a common oversight approach through standards and regulations.

In fact, Canada faces an enormous policy challenge in developing programs and initiatives to achieve broad reductions in the generation of GHG emissions across the country while allowing sufficient flexibility to account for regional circumstances. Sources and intensities of GHG emissions vary significantly from province to province, because of differences in industrial composition, population density, and other factors. However, a unifying factor across provinces is how energy is produced and used. The climate action plans reviewed in this report all contain numerous items to encourage energy conservation and to reduce society's energy intensity. This provides opportunities to learn from the best practices in other jurisdictions, and to better coordinate similar actions across jurisdictions. Coordination would provide opportunities for a common oversight approach through standards and regulations.

That each province has moved ahead with its own climate action plan does help address the issue of regional differences; however, it also raises important concerns about the regulatory effectiveness, efficiency, and additional burdens imposed by this decentralized approach. The lack of integration—or even coordination—between federal and provincial regulations and initiatives to reduce GHG emissions could be a significant impediment to achieving Canada's emissions reduction goals and deserves more careful analysis. Carbon pricing in particular provides a clear example of how the efficiency of GHG reduction policies, regulations, and programs could be significantly improved through better coordination and broader, more consistent application. A coordinated and broad initiative on carbon pricing could contribute to efficiency by providing a single market with a single set of requirements for participation, as well as a greater volume of trading to improve liquidity and the setting of prices.

The lack of integration—or even coordination—between federal and provincial regulations and initiatives to reduce GHG emissions could be a significant impediment to achieving Canada's emissions reduction goals.

REGULATORY EFFECTIVENESS, EFFICIENCY, AND BURDEN

When considering the regulatory effectiveness of GHG emissions reductions initiatives, it is important to recognize that most of the items included to date in provincial climate action plans are not formal regulations. The vast majority of action plan measures presented by provincial governments so far are programs, incentives, and other voluntary initiatives, rather than regulatory requirements.

However, some regulations have been put in place. For example, the federal government has introduced tailpipe emissions regulations and light-duty vehicle regulations in the transport sector. The federal and Nova Scotia governments have announced (and implemented in Nova Scotia's case) regulations to reduce GHG emissions from power generation. Alberta has introduced regulations that limit GHG intensity for large emitters. Several provinces have introduced, but not implemented, cap and trade legislation—the stumbling block appears to be progress on implementing cap and trade, whether regionally, nationally, or across North America.

Many of the measures are nothing more than repackaging of existing measures under a new logo.

Whether the action plan items are implemented through regulation or not, one of the fundamentals of good policy is a clear statement of the objectives. For the climate action plans, a primary objective is always to reduce GHG emissions, as part of the province's overall goal of meeting GHG reduction targets. The more important question, however, relates to the next level of detail regarding the contribution that each action item could make.

Another element of developing effective policies or regulations is a careful analysis of the options that can be implemented to achieve the policy objective. This analysis should include the anticipated impact of the policy and should be effectively communicated to all stakeholders, reflecting their input. Cost-benefit analysis and regulatory impact assessment are among the tools used to rank policy options. A careful review of the climate action plans indicates that at least the communication part of this work could be significantly improved. Although there are exceptions, the climate action plans consist primarily of a collection of measures, each of which will reduce GHG emissions. In most cases, the expected contribution of each measure is not quantified. Many of the measures that relate to energy efficiency and energy conservation are nothing more than repackaging of existing measures under a new logo. Building retrofit programs, appliance labelling initiatives, and other energy-saving measures that were developed decades ago in response to energy price increases are now being presented as climate action measures. Although such measures may contribute to reducing GHG emissions, most were in place in 1990, the reference year under Kyoto, and so emissions continue to rise.

To determine the effectiveness of climate action plans, the contribution of each measure to emissions reduction targets needs to be properly assessed and communicated. A positive example is Nova Scotia's climate action plan, which states the expected impact of most measures. However, greater specificity is required in all cases. Specific metrics that deal with issues such as additionality—that is, ensuring that incremental actions result in emissions reductions that are additional to what might have occurred anyway—should also be developed and communicated.

The action plans and supporting documents provide very little evidence that the specific impacts of any one action item have been measured.

Efficiency is clearly lacking. In most cases, the regulatory options considered during the development of emissions reduction policies have not been clearly articulated and evaluated against each other. The relative priorities for GHG emissions reductions are seldom identified. The action plans and supporting documents provide very little evidence that the specific impacts of any one action item have been measured, much less that alternative means of achieving the result have been examined, or that any priorities have been set for allocating government funds between action items. Although it is possible that this work has been done, a description of the process or results is not typically available.

For example, national tailpipe emissions standards are being implemented by the federal government, while federal and provincial governments are implementing renewable fuel standards. Each program has been evaluated for its GHG reduction benefits and related costs, which puts these programs at the head of the class. What is missing (or has not been communicated) is the analysis that considers the combined impact of these and other actions targeting vehicle emissions. What policy measures were considered before choosing these particular policies? How were they compared? How were tailpipe emissions and renewable fuel standards selected as the best options to implement? How does the combined impact of these measures compare with the sum of the impacts viewed independently? Similarly, how do federal tailpipe emissions work together with provincial regulations for speed-limiting devices? Can the individual impact of each policy be summed, or is there overlap? More broadly, how was the transportation sector identified as a priority, and how are government resources allocated among initiatives in this sector compared with other sectors? A careful review of the efficiency of GHG-reducing measures would respond to these and other questions.

The broader issue that the transportation example illustrates is the need to better coordinate between jurisdictions in order to improve the economic efficiency of the climate action plans as a package. In addition to cross-jurisdictional learnings around best practices, coordination offers the opportunity to develop and harmonize regulations, programs, and standards so that companies can develop one product for all internal Canadian markets, and consumers can rely on those products regardless of the province of origin. This coordination effort could also lead provinces to rethink programs and adopt more efficient measures as they are encountered. A public accounting and comparison of the action items and their impacts would contribute to this process and would give Canadians greater ability to understand and support the actions taken. The resulting cost savings to the economy should be measured and communicated.

When considering the best approach for regulating GHG emissions, a starting point might be to develop a clear statement of the regulatory objectives and timing.

Finally, Canada's federal and provincial governments all have their own individual targets for reducing GHG emissions with respect to both quantity and timing. The fact that the targets do not share a common time frame and are not coordinated between jurisdictions no doubt reduces regulatory effectiveness and efficiency, while increasing the burden on those subject to the regulations. Canada's economy is small and open, which means it relies heavily on both internal and external trade. Inter-provincial trade has long been impaired by a lack of harmony in regulatory requirements and standards, and

GHG regulations are no exception to the rule. The current patchwork of measures and incentives can serve as a disincentive for companies to cross provincial boundaries. And, because each province or territory has chosen its own path for reducing GHG emissions, there is a wide range of policy approaches, in terms of expenditures, funding sources, and methods for measuring progress. This diversity has created a significant burden for consumers or businesses that wish to participate in related programs or investments.

When considering the best approach for regulating GHG emissions, a starting point might be to develop a clear statement of the regulatory objectives and timing. Such a statement should facilitate measurements of effectiveness, efficiency, and burden. Regulatory effectiveness addresses whether or not the intended outcomes will be achieved; efficiency reflects the allocation of society's resources and whether the most cost-effective path was chosen; and burden considers the distribution of financial and other costs imposed by a regulatory approach. These three measures are essential elements of a comprehensive and ultimately successful GHG reduction plan.

APPENDIX A

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