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Preface

Canada, the world's second largest country by area and the eleventh largest economy in the OECD, has abundant natural resources. It is one of the world's biggest energy producers, as well as a major producer and exporter of agricultural products. Its vast territory hosts a great diversity of ecosystems and large tracts of it are undisturbed wilderness. This third *Environmental Performance Review* of Canada shows that it has successfully decoupled several environmental pressures from economic growth. Yet it faces challenges associated with high energy and resource consumption, high greenhouse gas emissions, and local pressures regarding biodiversity and water resources. While most Canadians enjoy clean air and good access to environmental services, many Indigenous communities lack equal access to essential services while being more exposed to environmental risks.

The federal government has established ambitious environmental goals and has re-affirmed its commitment to fight climate change and support clean economic growth through its unwavering support for the Paris Agreement.

In this respect, Canada is one of a number of countries which is leading by example. Canada has revived its engagement and leadership in international environmental initiatives. Following a decade where provinces were the primary driving force behind green growth policies, in December 2016, the federal government, the provinces and territories agreed on a Pan-Canadian Framework on Clean Growth and Climate Change – the first-ever collective vision focused on economic growth while reducing emissions and building resilience. This is a significant achievement and rigorous implementation will be important. To this end, better use of environmentally related taxation, which is very limited by OECD standards, can support Canada to achieve its goals. Improved collaboration with provinces and territories and enhanced engagement of Indigenous peoples in environmental decision making should also now be a priority.

The *Review* pays special attention to climate change mitigation (focusing on electricity generation and transport), as well as urban wastewater management. Canada is the fourth largest emitter of greenhouse gases in the OECD – and third largest emitter in per capita terms – and emissions show no clear sign of falling. Much of this is attributable to continuously rising fossil fuel use for the development of oil sands and for transport. Four provinces already have a carbon pricing mechanism in place and the Pan-Canadian Framework plans to introduce Canada-wide carbon pricing by 2018. Improving the emissions-intensity of the oil sands industry will be critical to achieve Canada's emission reduction targets.

On the issue of wastewater management, access to, and performance of, urban wastewater treatment is generally good in Canada. However, some large metropolitan centres like Vancouver and Montreal, and many Indigenous communities, lack access to advanced wastewater treatment systems. The development of a national strategy and the new national regulation on wastewater treatment have strengthened the policy framework, even though

the new regulation caused some overlap and misalignment with existing provincial and territorial regulation.

This *Review* is the result of a constructive policy dialogue between Canada and the other members and observers of the OECD Working Party on Environmental Performance. It provides 46 recommendations to help Canada keep greening its economy and improve its environmental governance and management.

I am confident that this collaborative effort will help Canada achieve both its goal of delivering solid economic growth, as well as complying with its internationally-agreed commitments to support better environmental policies for better lives in Canada, in the OECD, and beyond.



Angel Gurría

OECD Secretary-General

Foreword

The principal aim of the OECD Environmental Performance Review programme is to help member and selected partner countries improve their individual and collective performance in environmental management by:

- *helping individual governments assess progress in achieving their environmental goals*
- *promoting continuous policy dialogue and peer learning*
- *stimulating greater accountability from governments towards each other and public opinion.*

This report reviews Canada's environmental performance since the last review in 2004. Progress in achieving domestic objectives and international commitments provides the basis for assessing the country's environmental performance. Such objectives and commitments may be broad aims, qualitative goals or quantitative targets. A distinction is made between intentions, actions and results. Assessment of environmental performance is also placed within the context of Canada's historical environmental record, present state of the environment, physical endowment in natural resources, economic conditions and demographic trends.

The OECD is indebted to the federal government of Canada and the governments of Alberta and Quebec for their co-operation in providing information, for the organisation of the review mission to Ottawa, Quebec City and Edmonton (17-24 January 2017) and the policy mission to Ottawa and Quebec City (10-14 April 2017), and for facilitating contacts both inside and outside government institutions.

Thanks are also due to the representatives of the two examining countries, Alexis Cain (United States) and Andrew Pankowski (Australia).

The authors of this report were Britta Labuhn, Xavier Leflaive, Eugene Mazur, Paul O'Brien (all OECD Secretariat) and Rachel Samson (consultant). Nathalie Girouard and Britta Labuhn provided oversight and guidance. Carla Bertuzzi provided statistical support; Mika Hosokawa and Clara Tomasini provided administrative support; and Mark Foss copy-edited the report. Preparation of this report also benefited from valuable comments and inputs from several members of the OECD Secretariat, including Johanna Arlinghaus, Andrew Barker, Richard Baron, Nils Axel Braathen, Simon Buckle, David Carey, Kathleen Dominique, Luisa Dressler, Tatiana Efimova, Katia Karousakis, Hannah Leckie, Oriana Romano, Dirk Röttgers, Ronald Steenblik, Simon Upton and Kurt Van Dender. Thanks are also due to Sylvia Beyer, George Kamiya and Caroline Lee from the International Energy Agency.

The OECD Working Party on Environmental Performance discussed the draft Environmental Performance Review of Canada at its meeting on 28 June 2017 in Paris, and approved the Assessment and Recommendations.

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Reader's guide

Signs

The following signs are used in Figures and Tables:

. . : not available

– : nil or negligible

. : decimal point

Country Aggregates

OECD Europe: This zone includes all European member countries of the OECD, i.e. Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

OECD: This zone includes all member countries of the OECD, i.e. the countries of OECD Europe plus Australia, Canada, Chile, Israel,* Japan, Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.

Currency

Monetary unit: Canadian dollar (CAD).

In 2016, USD 1.00 = CAD 1.33

In 2015, USD 1.00 = CAD 1.28

In 2014, USD 1.00 = CAD 1.11

Cut-off date

This report is based on information and data available up to May 2017.

Disclaimer

* The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

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Abbreviations and acronyms

AQMS	Air Quality Management System
CAFE	Corporate average fuel economy
CCME	Canadian Council of Ministers of the Environment
CCS	Carbon capture and storage
CEAA	Canadian Environmental Assessment Agency
CEPA	Canadian Environmental Protection Act
CO_2eq	Carbon dioxide equivalent
CWWA	Canadian Water and Wastewater Association
EA	Environmental assessment
ECCC	Environment and Climate Change Canada
EEA	Environmental Enforcement Act
EEZ	Exclusive Economic Zone
EGS	Environmental goods and services
EMS	Environmental management systems
EPR	Environmental Performance Review
FCM	Federation of Canadian Municipalities
FSDS	Federal Sustainable Development Strategy
GDP	Gross domestic product
GHG	Greenhouse gas
INAC	Indigenous and Northern Affairs Canada
LULUCF	Land use, land-use change and forestry
NDC	Nationally Determined Contribution
NEB	National Energy Board
NGOs	Non-governmental organisations
NO_x	Nitrogen oxides
ODA	Official development assistance
PCF	Pan-Canadian Framework on Clean Growth and Climate Change
PM	Particulate matter
PPP	Purchasing power parity
R&D	Research and development
RD&D	Research, development and deployment
SEA	Strategic environmental assessment
SMEs	Small and medium-sized enterprises
SO_x	Sulphur oxides
SUVs	Sport utility vehicles
TFC	Total final energy consumption
TPES	Total primary energy supply
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNFCCC	United Nations Framework Convention on Climate Change
WSER	Wastewater Systems Effluent Regulations

BASIC STATISTICS OF CANADA (2015 or latest available year)*

(OECD values in parentheses)[a]

PEOPLE AND SOCIETY

Population (million)	36.1	(1 274)	Population density per km^2	4	(35)
Share of population by type of region:			Population compound annual growth rate, latest 5 years	1.1	(0.6)
Predominantly urban (%)	56.8	(47.5)	Income inequality (Gini coefficient)	0.32	(0.32)
Intermediate (%)	15.9	(27.4)	Poverty rate (% of population with less than 50% med. income)	13	(11)
Rural (%)	27.3	(25.1)	Life expectancy	82	(81)

ECONOMY AND EXTERNAL ACCOUNTS

Total GDP (GDP, CAD billion)	1 986		Imports of goods and services (% of GDP)	34	(29)
Total GDP (GDP, USD billion, current PPPs)	1 591	(51 188)	Main exports (% of total merchandise exports)		
GDP, latest 5-year average real growth (USD PPPs, compound annual growth rate)	2.2	(1.7)	Mineral fuels, mineral oils and products of their distillation; bituminous substances	19	
GDP per capita (1 000 USD, current PPPs)	44	(41)	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof	15	
Value added shares (%)			Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	8	
Agriculture	1.8	(1.8)	Main imports (% of total merchandise imports)		
Industry including construction	28.8	(24.8)	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof	16	
Services	69.3	(73.4)	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	15	
Exports of goods and services (% of GDP)	32	(29)	Electrical machinery and equipment and parts thereof; television image, sound recorders and parts thereof	10	

GENERAL GOVERNMENT

Percentage of GDP

Expenditure	41.2	(41.8)	Education expenditure[b]	4.5	(4.4)
Revenue	39.8	(38.7)	Health expenditure[b]	7.2	(6.6)
Gross financial debt	98.4	(113.2)	Environment protection expenditure	..	(0.5)
Fiscal balance	-1.3	-(3.1)	Environmental taxes: (% of GDP)	1.1	(1.6)
			(% of total tax revenue)	3.7	(5.2)

LABOUR MARKET, SKILLS AND INNOVATION

Unemployment rate (% of civilian labour force)	6.9	(6.8)	Patent applications in environment-related technologies (% of all technologies)[c]	11.3	(11.7)
Tertiary educational attainment of 25-64 year-olds (%)	55	(35)	Environmental management	4.7	(4.4)
Gross expenditure on R&D (% of GDP)	1.6	(2.4)	Water-related adaptation technologies	0.7	(0.5)
			Climate change mitigation technologies	8.3	(9.4)

ENVIRONMENT

Energy intensity: TPES per capita (toe/cap.)	7.5	(4.1)	Road vehicle stock (veh./100 inhabitants)[d]	65.9	(68.2)
TPES per GDP (toe/1 000 USD, 2010 PPPs)	0.18	(0.11)	Water stress (abstraction as % of available resources)	1.0	(9.7)
Renewables (% of TPES)	18.2	(9.6)	Water abstraction per capita (m^3/capita/year)	1 015	(819)
Carbon intensity (energy-related CO_2):			Municipal waste per capita (kg/capita)[e]	409	(520)
per capita (t/cap.)	15.5	(9.4)	Material productivity (USD, 2010 PPPs/DMC, kg)	0.5	(1.7)
per GDP (t/1 000 USD, 2010 PPPs)	0.37	(0.26)	Land area (1 000 km^2)	9 094	(34 404)
GHG intensity:[f]			% of arable land and permanent crops	5.6	(12.2)
per capita (t/cap.)	20.5	(12.4)	% of permanent meadows and pastures	1.6	(23.4)
per GDP (t/1 000 USD, 2010 PPPs)	0.49	(0.34)	% of forest area	38.2	(31.3)
Mean population exposure to air pollution ($PM_{2.5}$), µg/m^3	12	(14)	% of other land (built-up and other land)	54.7	(33.1)

* Values earlier than 2010 are not taken into consideration.

a) OECD value: where the OECD aggregate is not provided in the source database, a simple OECD average of the latest available data is calculated.

b) Total public expenditure.

c) Higher-value inventions that have sought patent protection in at least two jurisdictions, average of latest 3 years.

d) Includes two-wheeled vehicles.

e) Data for Canada refer to household waste only.

f) Excluding emissions/removals from land use, land-use change and forestry.

Source: Calculations based on data extracted from databases of the OECD, IEA/OECD, EUROSTAT and the World Bank.

Executive summary

The second largest country in the world by area, Canada endows vast natural resources and a great biological diversity. Natural-resource based activities such as mining, fossil fuel extraction, agricultural forestry and fisheries provide for an important share of national income and exports. Canadians generally enjoy a high level of well-being, although parts of the population, particularly Indigenous peoples, lack equal opportunities and access to essential services. While Canada has decoupled a number of environmental pressures from economic growth, it remains one of the most energy- and resource- intensive economies in the OECD. Canada is the fourth largest emitter of greenhouse gases in the OECD and emissions show no sign of falling yet. Fossil fuels remain the dominant energy source. The emission of local air pollutants decreased, but outdoor air pollution continues to harm Canadians. Waste is predominantly landfilled and recycling rates are low in most provinces and territories. Pressures on biodiversity and water bodies remain high in certain areas.

Green growth

Canada has strengthened its commitment to "clean growth" and begun to build a strong policy framework for its delivery. A Federal Sustainable Development Strategy, developed every three years and involving more than 30 federal departments and agencies, promises better integration of environmental considerations into sectoral policies. The 2016 Pan-Canadian Framework for Clean Growth and Climate Change (PCF) presents Canada's first-ever overarching plan to grow the economy, while reducing emissions and building resilience. Developed in a co-ordinated approach among federal, provincial and territorial levels, the framework aims to introduce Canada-wide carbon pricing, accelerate innovation, support clean technology and create jobs. Most components are still being put into action.

Expanding carbon pricing and the focus on clean technology and major infrastructure investments will send important signals and promise to boost innovation and domestic demand for cleaner products and environmental services. Canada files far fewer environmental patents per capita than leading OECD member countries; and its share of the global clean technology market has fallen since 2005. Yet more remains to be done on the fiscal front. Canada's use of environmentally related taxation is far below that of other OECD member countries. Petrol and diesel taxes for road use are among the lowest in the OECD, fossil fuels used for electricity and heating remain untaxed or taxed at low rates in most jurisdictions and the federal excise tax on fuel-inefficient vehicles is an ineffective incentive to purchase low-emission vehicles. There has also been little use of economic instruments to limit water use, waste generation, or air and water pollution. Fossil fuel support has been reduced by almost half since 2004, yet a number of support measures remain, notably at the provincial level.

Environmental governance

The current government has made it a priority to enhance the engagement of Indigenous peoples in environmental decision making and improve collaboration with provinces and territories. Being a federal country, many environmental responsibilities are shared with sub-national governments. Canada has improved the effectiveness of multi-level environmental governance in the area of climate change and air quality management, for example. Further efforts are needed to manage overlapping powers and promote consistent national progress in the areas of environmental assessment, biodiversity and waste management. Canada could strengthen its regulatory practices by adopting good international practices in environmental assessment and permitting, and by more rigorously applying strategic environmental assessment on sub-national levels.

Climate change mitigation

Canada has made continual progress in decoupling greenhouse gas emissions from economic growth. However, total emissions have fallen back only slightly compared with the 2005 level, and are almost 20% above the 1990 level. Canada reduced emissions from electricity generation by 38% since 2000, much driven by the phase-out of coal-fired electricity generation in Ontario. The country's electricity mix is already among the least carbon-intensive in the OECD, with about 80% of electricity coming from non-emitting sources (mostly hydro and nuclear). Canada is becoming a leader in carbon capture and storage, running the world's first commercial carbon capture application to a coal-fired power plant. At the same time, emissions from domestic transport and the oil sands industry have grown steadily, effectively offsetting reductions achieved in other sectors. Together, transport and oil and gas sectors now account for half of national emissions.

Following Canada's withdrawal from the Kyoto Protocol, climate policy has been driven largely by provinces. Alberta, British Columbia, Ontario and Quebec – the four most populous provinces – have a carbon pricing mechanism in place. The PCF constitutes Canada's first explicit nation-wide mitigation strategy to cut emissions. Its core feature is the introduction of a federal "benchmark" carbon price of CAD 10 per tonne of CO_2 as of 2018. Provinces and territories can achieve the benchmark through a carbon tax, a permit-based system or a hybrid approach. Notwithstanding the flexibility of the new approach, it will be challenging to implement. A strong accountability mechanism will be needed to track and compare progress across provinces. Beyond carbon pricing, the PCF foresees to phase out coal-generated electricity, to develop a federal clean fuel standard and to regulate methane emissions from the oil and gas industry. The latter will be critical: without a drastic decrease in the emissions intensity of the oil sands industry, the projected increase in oil production may seriously risk the achievement of Canada's climate mitigation targets.

Urban wastewater management

Effluent from urban wastewater systems represents one of the largest sources of pollution into Canadian waters by volume. The impact on water quality and ecosystems is, however, not well-known. New contaminants emerge as an issue of concern and may require more systematic action to build adequate monitoring and management capacity. Canadians generally benefit from reliable access to, and good performance of, wastewater treatment. The condition of urban waste- and rainwater infrastructure has improved significantly over the last two decades. Yet a relatively large share of the population still relies on primary

wastewater treatment, including some large metropolitan centres and many Indigenous communities.

To improve performance, governments adopted a national strategy and the first-ever federal effluent quality standards (equivalent to secondary level of treatment). A long-term strategy is needed to secure funding for system upgrades and better adapt urban wastewater management to climate change. At current reinvestment levels, it would take about 100 years to renew existing infrastructure. Most municipalities charge for wastewater services, but rates are generally too low to recover costs. Some municipalities embark in innovative urban design, for example by connecting waste- or rainwater with resource management. These innovations depend on local initiatives and are not backed by federal policy. Access of Indigenous communities to modern wastewater treatment systems improved significantly thanks to sustained financial support from the federal government. Still, more than half of wastewater systems in these communities are considered medium overall risk.

Assessment and recommendations

The Assessment and recommendations present the main findings of the Environmental Performance Review of Canada and identify 46 recommendations to help Canada make further progress towards its environmental policy objectives and international commitments. The OECD Working Party on Environmental Performance reviewed and approved the Assessment and recommendations at its meeting on 28 June 2017. Actions taken to implement selected recommendations from the 2004 Environmental Performance Review *are summarised in the Annex.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Environmental performance: Trends and recent developments

Canada is the world's second largest country by area, and the eleventh largest economy in the OECD. It is more reliant on the use of natural capital than most other OECD member countries. Fossil fuel and mineral extraction industries, agriculture, forestry and fisheries account for around 10% of gross domestic product (GDP) and 40% of exports. As one of the world's largest energy producers, Canada has much benefited from the commodities boom in the 2000s, although the fall in oil prices since mid-2014 has slowed growth. Canadians generally enjoy a high quality of life. However, parts of the population, including many Indigenous communities, lack equal access to essential services, while being more vulnerable to environmental degradation and the effects of climate change.

Economic growth has come with increased environmental pressures. The country faces challenges associated with high energy and resource intensity, high emissions of greenhouse gases (GHGs) and pressures on biodiversity and water resources. The federal government elected in 2015 established ambitious environmental goals and injected new momentum for advancing environmental policy across the country. This includes improved collaboration with provinces and territories, which have wide responsibility for environmental policies, as well as a commitment to reconciliation and rebuilding of nation-to-nation relationships with Indigenous peoples.

Transition to a low-carbon and energy-efficient economy

Canada is the fourth largest GHG emitter and one of the most carbon-intensive economies in the OECD. While GHG emissions have been decoupled from economic growth since 2000, they decreased more slowly (-1.5%) than in the OECD as a whole (-4.7%). Emissions dropped considerably during the 2008/09 global financial crisis, but have been rising since (Figure 1). The increase was driven mainly by increasing fossil fuel consumption in transport and oil sands mining. The emissions profiles vary significantly across provinces, reflecting differences in natural resource endowments, electricity production and economic activity. Alberta, which accounts for nearly 40% of national emissions, saw its emissions surge by 18% over 2000-15, largely due to the development of oil sands. Emissions have also risen in Saskatchewan, Newfoundland and Nunavut, while they have decreased in all other provinces and territories. Energy production and consumption are responsible for about 80% of Canada's emissions.

Canada has a target to reduce GHG emissions by 30% from 2005 levels by 2030. This is demanding in terms of reducing emissions intensity, even if it is not much more ambitious than the targets previously set under the 1997 Kyoto Protocol and the 2009 Copenhagen Accord (Figure 1). Canada will need to implement additional policies beyond those in place in November 2016 to meet its 2030 target. Until recently, Canada's climate policy has been driven mainly by provinces, without an overarching national framework. In December 2016, Canadian First Ministers announced the Pan-Canadian Framework on Clean Growth and Climate Change (PCF) to co-ordinate and accelerate efforts to mitigate GHG emissions to meet Canada's 2030

Figure 1. **Selected environmental performance indicators**



a) Government of Canada emissions projections with policies and measures in place as of 1 November 2016.
b) Breakdown excludes electricity trade.
c) Non-hazardous waste from residential and non-residential sources, includes industrial waste and construction and demolition waste.
d) At 2010 prices and PPPs.
e) IUCN Protected Areas Categories System: I-II Strict nature reserve, Wilderness area, National park; III-IV Natural monument /feature, Habitat/species management area; V-VI Protected landscape/seascape, Protected area with sustainable use of natural resources.
Source: ECCC (2017), *National Inventory Report 1990-2015*; ECCC (2017), *Air Pollutant Emission Inventory Report 1990-2015*; IEA (2016), *IEA World Energy Statistics and Balances* (database); OECD (2017), *OECD Environment Statistics* (database); OECD (2017), *OECD National Accounts Statistics* (database); Statistics Canada (2016), *Water Withdrawal and Consumption by Sector.*

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target (Section 4). Putting in place Canada-wide carbon pricing, a key pillar of the framework, will be essential. This will correct currently limited taxation and low prices for high-carbon energy, which have discouraged investment in renewable energy and energy efficiency. With temperatures in Canada rising nearly twice as fast as the global average since 1950, the country also needs to continue building adaptation measures to face expected challenges such as rising sea levels, and more frequent and intense weather events (ECCC, 2016b).

Fossil fuels continue to dominate Canada's energy mix. They accounted for 74% of total primary energy supply in 2015, only marginally less than in 2000 (Figure 1). The share of renewable energy has stayed below 20%; much of Canada's vast renewable energy potential remains untapped (IEA, 2016). CO_2 emissions from energy use were therefore not significantly decoupled from energy supply, despite a welcome decline in the use of coal for electricity generation. This decline was driven mainly by the phase-out of coal-fired electricity generation in the province of Ontario. The announced phase-out of coal-fired generation in the country by 2030 and the planned establishment of a federal clean fuel standard are, however, expected to reduce CO_2 emissions from energy use. Canada is also leading large-scale carbon capture and storage (CCS) pilots, whose development would help curb CO_2 emissions further (Section 4).

Canada has one of the least carbon-intense electricity mixes in the OECD. Thanks to the strong role of hydro and nuclear power, about 80% of electricity comes from non-emitting sources, up from 73% in 2000. The electricity mix varies across provinces and territories, however. Quebec and Manitoba source nearly 100% of power from hydro; Ontario relies on nuclear; and fossil fuels dominate in Alberta, Nova Scotia and Saskatchewan. The growing demand for electricity was met mainly by additional nuclear and, since the late 2000s, a remarkable expansion in wind power. By the end of 2016, Canada had the eighth-largest wind power capacity in the world.

Despite progress, Canada remains one of the most energy-intensive economies in the OECD. High energy intensity reflects the country's large heavy industry, including the extraction and processing of minerals and fossil fuels for exports. Some energy-intensive sectors have become more energy efficient (e.g. iron, steel, pulp and paper). However, this has been more than offset by rising demand from the mining and quarrying sectors, including oil and gas extraction, as well as road transport and households.

Outdoor air pollution continues to harm the health of Canadians. About 30% of Canadians live in areas where outdoor levels of fine particulate matter ($PM_{2.5}$) and/or ozone exceed national air quality standards, mostly in cities in Ontario and Quebec (the most populous provinces). Emissions of $PM_{2.5}$ have declined in the early 2000s and remained relatively stable since. Canada still has the highest emission level per unit of GDP in the OECD. Trans-boundary air pollution is significant. Environment and Climate Change Canada (ECCC) estimates that annual $PM_{2.5}$ concentrations are strongly influenced by US sources, notably in the border regions; pollution originating in East Asia affects particulate matter and ozone concentrations on Canada's west coast during the spring and summer season. The emission of other air pollutants has decreased since 2000 (Figure 1), reflecting the phase-out of coal in electricity generation, stricter regulations for trucks and vehicles, technological improvements in heavy industry (e.g. non-ferrous smelting and refining facilities) and closure of major smelters.

In 2012, Canada introduced the Air Quality Management System (AQMS), a national management system for air emissions and outdoor air quality. Under the AQMS, Canada

strengthened national outdoor air quality standards for $PM_{2.5}$ and ground-level ozone. It also set up the first-ever mandatory emissions standards that cover boilers, heaters and engines, and the cement sector. It published "codes of practice" for the aluminium and the iron, steel and ilmenite sector, and proposed a code of practice for the pulp and paper industry. No standards or codes of practice exist for some other heavily polluting sectors such as oil sands or petroleum refineries. Continued efforts are needed to manage non-point sources, including particulate matter emissions from construction operations and ammonia emissions from agriculture.

Improving resource efficiency

Canada is among the most material-intense economies in the OECD. Resources consumed per capita (measured by weight) and resources needed to generate a unit of GDP are high even compared to other resource-rich OECD economies with strong mining and construction industries. Technological and process innovation, as well as greater use of recycled materials, would help Canada improve its resource efficiency. This would also contribute to green growth objectives, including climate mitigation and growth in clean tech segments (Section 3).

Generation and treatment practices of solid waste vary widely across the country, reflecting heterogeneous goals, regulations and incentives for waste reduction and recovery. The share of waste diverted (i.e. recycled or composted) ranges from 14% in Saskatchewan to 40% in Nova Scotia. Northern communities face specific challenges with the collection and disposal of environmentally-harmful wastes, open burning and outdated disposal infrastructure. Nationally, nearly three-quarters of waste continues to be landfilled, while only one-quarter is diverted (Figure 1), significantly less than in most other OECD member countries. One of the main obstacles is the low cost of landfilling in many provinces, even in respect of material streams for which recycling technologies and markets exist (e.g. metals). The 2009 Canada-wide Action Plan for Extended Producer Responsibility was a major step forward for harmonising and accelerating the implementation of resource recovery schemes across jurisdictions. However, harmonisation of definitions and data remains a challenge. Major waste-producing sectors, such as construction and demolition waste, are not yet covered in the schemes. Initiatives such as the 2014 Shared Vision for Waste and the National Zero Waste Council aim to promote further progress in waste diversion.

Canada has significantly expanded its use of agricultural chemicals. The application of nitrogen fertilisers increased more than twice as fast as agricultural production since the early 2000s, and faster than in any other OECD member country. This has intensified pressures on water quality in the Great Lakes, Lake Winnipeg and the St. Lawrence River basin, among others. The use of pesticides has increased by about 40% over the past five years. At the same time, regulatory oversight was found to be insufficient to ensure protection of human health and the environment (OAG, 2015). The share of organic farming in Canada remains low.

Canada was one of the first countries to systematically start addressing the risks of legacy chemicals. Under the 2006 Chemicals Management Plan, some 23 000 chemicals were prioritised. Of these, 4 300 substances have been identified for further review, which the government has committed to complete by 2020. Approximately 70% of these priority substances have been assessed to date. Some 80 risk management measures have been put in place to address the effect of these substances on human health and the environment.

Managing the natural asset base

Canada's vast territory harbours a great diversity of territorial and marine ecosystems, including about 9% of the global forest area, 25% of remaining wetlands and the world's longest coastline. However, wetlands and grasslands continue to be lost, even if the rate of loss has slowed. Habitat loss and fragmentation, invasive species and disease, overexploitation of natural resources, pollution and climate change constitute the main pressures on Canada's natural environment (CCRM, 2010). Canada has reiterated its commitment to conserve at least 17% of land and 10% of coastal and marine area by 2020. However, this will be challenging to achieve (Figure 1). A framework to guide the development and implementation of a terrestrial protected areas network, currently under development, will help accelerate the establishment of new areas across jurisdictions. It could also help improve the representativeness of ecosystems in the protected area network, as well as the ecological connectivity between areas. Canada has not signed the Nagoya Protocol on Access and Benefit Sharing and lacks a comprehensive system that would support its implementation.

Canada has an estimated 7% of the world's renewable freshwater supply. However, about 60% of that renewable supply flows northward, away from the general population. Several areas along the southern border have faced a high threat to water availability. This situation will likely worsen under continuing urbanisation and climate change. Freshwater abstraction, measured per capita, remains one of the highest in the OECD, reflecting the abundance of water in some areas and water-intensive natural resource sectors (such as agriculture, mining and oil and gas development, and fossil-fuel-powered electricity generation), as well as low water prices. Only a few provinces charge for water abstraction, or have systems to re-allocate resources in times of water stress. Recent reforms have introduced fees for water permits (e.g. Quebec) and limited trading of water rights (e.g. Alberta). These could serve as examples to other jurisdictions facing water stress. Water quality is generally fair to good, but nutrient pollution from agriculture, and urban and industrial wastewater, is increasing pressures in some areas. Poor drinking water quality disproportionately affects Indigenous peoples, who have lower access to adequate water supply and sanitation (Section 5).

Recommendations on air, materials, water and biodiversity management

Air pollution

- Develop standards for all heavily polluting sectors and activities (e.g. refineries and oils sands development) under the Air Quality Management System; continue to improve knowledge of the relative health impacts and associated costs of the individual components of $PM_{2.5}$ pollution to allow for more effective mitigation actions; continue efforts to manage non-point sources; continue to pursue co-operation with the United States and other countries affected by, or contributing to, transboundary air pollution.

Materials, waste management and circular economy

- Continue to develop extended producer responsibility schemes, prioritising key waste-generating sectors (e.g. from the industrial, commercial and construction sectors) and waste streams with large recycling potential (e.g. metals); ensure coherence and, where possible, harmonisation of schemes across jurisdictions, while strengthening the availability and comparability of data to monitor and track progress.

Recommendations on air, materials, water and biodiversity management *(cont.)*

- Encourage waste prevention and recovery of materials not covered under extended producer responsibility schemes (e.g. organic waste) by: i) expanding landfill charges; ii) making greater use of waste collection charges for household waste; iii) raising awareness among citizens and businesses; and iv) considering the possibility of incentives (e.g. fiscal incentives) for recycled products to support the development of recycling markets and infrastructure; facilitate the diffusion of best practices across jurisdictions, while paying particular attention to improving waste practices in northern communities.

Water management

- Consider the introduction of water abstraction charges, in particular in watersheds where water is scarce or competition to access the resource intensifies; continue efforts to reform water allocation regimes, with a view to establish abstraction caps, define priority users and build mechanisms for effective water re-allocation in regions facing water scarcity.

Biodiversity management

- Accelerate efforts and collaboration across jurisdictions to conserve at least 17% of terrestrial areas and inland water by 2020; expand protected areas in the southern part of the country; and substantially increase the total area of marine and wetland ecosystems under protection.
- Develop and implement a national policy on access and benefit sharing of genetic resources to lay the ground for accession to the Nagoya Protocol.

2. Environmental governance and management

Institutional framework

The environment is an area of concurrent jurisdiction between the federal and provincial or territorial governments. Provinces have historically had the leading role in environmental protection, with limited responsibilities delegated to municipalities (mostly for environmental services). The federal government's environmental authority focuses primarily on issues of national concern, such as regulation of toxic substances, cross border pollution, and protection of fisheries and marine areas; the federal government also plays a role of co-ordination and guidance. Powers between the federal and sub-national government levels often overlap with regard to particular environmental issues. Several multi-level governance mechanisms facilitate close collaboration in policy and regulatory development and implementation. These include the Canadian Council of Ministers of the Environment and issue-specific councils and working groups, as well as equivalency and administrative agreements between federal, provincial and territorial environmental authorities. Still, responsibilities overlap in several areas, including environmental assessment and water and biodiversity protection. This leads to occasional tensions between the two levels of government and may need further clarification. Improved partnerships with provincial, territorial and municipal governments are an explicit mandate of the federal Minister of the Environment and Climate Change (PMO, 2017).

The elaboration of inter-jurisdictional agreements requires substantial time and resources, and their coverage remains limited. Recent experiences of collaborative development of federal-provincial-territorial policy frameworks on climate change

(Section 4) and air pollution (Section 1) have been positive. Under these frameworks, the parties jointly established minimum performance standards while leaving flexibility for provinces and territories on how to reach them. This could provide a model to address other pressing environmental issues that require significant cross-jurisdictional partnership, such as achieving the Aichi targets related to protected areas and shifting towards integrated spatial planning approaches in land-use planning. There is also a need for better standardisation of data collection and methodologies and inter-jurisdictional exchange of information to support environmental decision making at the federal and provincial levels.

The relationship with Indigenous peoples (First Nations, Inuit and Métis) is an important element of Canada's institutional framework. There are 26 modern treaties – Comprehensive Land Claim Agreements – and 4 self-government agreements signed since 1973, covering over 40% of the country (including most of the land in the territories). They are negotiated between Indigenous peoples, the federal government, and the province or territory and implemented through legislation. These agreements provide certainty for all parties about the ownership, use and management of land and natural resources, including harvesting and sub-surface rights, resource revenue-sharing and environmental management. They have established new governance regimes that have significantly enhanced Indigenous communities' influence over land, wildlife and resource decisions. Federal, provincial and territorial governments are working extensively with local Indigenous groups and communities.

There is improved co-ordination between the federal environment, health and other departments, particularly in the framework of Federal Sustainable Development Strategies. Provincial horizontal bodies such as the Natural Resource Board of British Columbia, Alberta's Natural Resources Conservation Board and Quebec's Inter-Ministerial Committee for Sustainable Development also play an important role in environmental governance. There is growing horizontal collaboration across municipalities in the provision of water supply, sanitation and waste management services.

Regulatory requirements

The federal government uses regulatory impact analysis for all regulatory proposals, including cost-benefit analysis for all significant ones. Potential environmental, economic and social impacts are all part of the scope of the analysis. Provinces and territories have similar regulatory assessment processes for proposals under their jurisdiction.

Canada has strengthened its requirements for strategic environmental assessment (SEA) at the federal level in line with a recommendation of the 2004 *Environmental Performance Review*. However, a recent review of selected federal departments showed that only a few of them use this instrument well. Less than a quarter of audited policy, plan and programme proposals with potentially important environmental effects underwent SEA (OAG, 2016). More needs to be done to implement SEA at the provincial level, where there are few SEA requirements.

Ex post evaluation of regulatory programmes has gained high political priority. It plays a key role in supporting the federal government's commitment to ensuring value for money in the delivery of its policy commitments. Particular emphasis has recently been placed on measuring outcomes.

Environmental assessment (EA) is conducted by the federal, provincial and territorial governments for projects under their respective jurisdictions. The number of projects subject

to EA at the federal level decreased significantly following the revision of the Canadian Environmental Assessment Act in 2012 (OAG, 2014). In 2016, the Minister of Environment and Climate Change established an Expert Panel to review federal environmental assessment processes in order to restore public confidence in the credibility of EA. In 2017, the panel recommended creation of a single authority in charge of all federal-level EA. Further, it emphasised the importance of co-operation among jurisdictions, integrating Indigenous considerations into decision making and ensuring meaningful public participation.

Several provinces have introduced integrated environmental permitting. However, this integration is mostly procedural. It does not provide for holistic management of environmental impacts through application of best available techniques. Moreover, environmental permitting in many provinces is not well integrated with EA. For example, conditions set in permits and EA decisions are often enforced separately. There are a few positive examples (e.g. in Ontario and Quebec) of simplified permitting regimes for facilities with low environmental risk.

There is no national land-use planning in Canada, and all provinces and territories have their own land-use planning systems. Provinces and territories with few inhabitants tend to centralise land-use planning. In contrast, those with a large number of inhabitants tend to delegate more power to local governments. Municipalities have low institutional capacity and lack an SEA requirement for land-use planning. This impedes systematic consideration and integration of environmental aspects into community and district plans and better assessment of cumulative environmental effects of economic activities. Indigenous peoples' rights are a major issue in land use: plans in Indigenous communities do not have legal force, and free, prior and informed consent is not always obtained. The federal and provincial governments encourage development companies to negotiate impact-benefit agreements with Indigenous peoples to settle financial compensation, provision of jobs and eventual environmental restoration. However, companies are under no obligation to do so, the government is not a party to the agreements, and the agreements seldom result in changes to the project itself.

Compliance assurance

Both federal and several provincial environmental authorities conduct risk-based planning of environmental inspections, which takes into account the compliance record of regulated entities. Criminal penalties for environmental violations are high, can be doubled for subsequent offences and levied for each day an offence continues. However, they do not account for the economic benefit to the offender of non-compliance. The federal government, British Columbia and Quebec have recently introduced administrative fines for moderate non-compliance. This decriminalises minor offences and makes the application of sanctions more flexible. However, only limited enforcement data are disclosed to the public.

Different Canadian jurisdictions have introduced good enforcement practices with respect to sanction policies, public disclosure of enforcement records and measurement of outcomes. For example, British Columbia provides guidance to inspectors on making proportionate enforcement decisions. Several attempts to develop outcome indicators of environmental enforcement activities have not institutionalised the practice. However, they show the growing focus on performance management of compliance assurance at the federal and provincial levels.

Canada has several environmental liability regimes under federal and provincial law. Liability is strict (irrespective of fault) with respect to past pollution. It is generally applied to contaminated land, but not to damage to water bodies and ecosystems. The federal and provincial governments require financial assurance (letters of credit, trust funds, guarantees or insurance) in several sectors, including mining and energy, to make sure that polluters bear the costs of clean-up and remediation. Several provinces have established regulatory regimes for the assessment and remediation of contaminated sites. Some, such as Ontario and Alberta, have created special funds to pay for the clean-up if a financially solvent responsible party cannot be identified. The recent requirement for governments to include in their balance sheet remediation costs for contaminated sites they own is an incentive to accelerate clean-up of public lands.

Federal and provincial environmental authorities increasingly recognise the importance of compliance promotion. They use a variety of information-based tools (electronic and face-to-face dissemination of information and guidance) to reach out to enterprises, especially small and medium-sized ones, in key activity sectors as well as Indigenous communities.

In line with the 2004 EPR recommendation to continue to develop cost-effective voluntary approaches with industry, ECCC uses performance agreements that commit participating sectors or companies to specific challenges or performance levels. ECCC has signed 14 such agreements (mostly related to air quality) with different industries, including chemicals, transportation, metal processing, consumer products, forestry and printing. Three of the 14 are currently in effect. Eight of the eleven agreements completed fully achieved their objectives, while others had mixed results.

The federal and most provincial and territorial governments actively use public procurement to support green business practices. However, the government does not offer regulatory incentives (such as lower inspection frequency or reduced permit fees) to enterprises to adopt and certify environmental management systems (EMS). This contributes to the recent slowdown of EMS certifications in Canada.

Environmental democracy

Public consultation is a prominent feature of Canadian government decision making. Stakeholders and the public are consulted before federal or provincial statutes or regulations are passed and, extensively, as part of the EA process. The latest Federal Sustainable Development Strategy (Section 3) and the Pan-Canadian Framework for Clean Growth and Climate Change (Section 5) are the most recent examples of broad engagement of civil society at different levels. Outreach is accomplished through working groups with multiple stakeholders, town hall meetings and interactive websites. Special attention is given to meaningfully engage and partner with representatives of Indigenous peoples.

Consultation with Indigenous groups is an obligation of the federal, provincial and territorial governments, which has been confirmed by several decisions of the Supreme Court of Canada. In addition, formal consultation protocols provide for a participatory process for assessing the environmental implications of projects on Indigenous lands. However, Indigenous peoples often feel they have not had the opportunity to meaningfully participate in environmental decision making, and that consultation often occurs too late in the process. In 2016, Canada officially removed its objector status to the UN Declaration on the Rights of Indigenous Peoples and declared that it intends to fully implement it.

However, Indigenous communities and organisations often lack capacity to meaningfully participate in consultation processes. Many conflicts with respect to specific natural resource development projects continue.

Canada has federal, provincial/territorial and municipal legislation on access to information that compels disclosure of government information to the public. There are several sources of government and private-sector environmental data, including the Canadian Environmental Sustainability Indicators website and the National Pollutant Release Inventory, as well as EA registries and enforcement databases (including through the National Energy Board). The federal government has released a number of reports on the state of the environment. However, there are challenges regarding the comparability and timeliness of published information, notably in the area of waste management.

The Canadian public has a broad right to petition the government on environmental issues and to appeal environmental permits or approvals to an administrative tribunal. In all Canadian jurisdictions, an individual or a non-governmental organisation (NGO) can take legal action against a polluter or initiate a judicial review of the government's environmental decision. Over the last decade, there has been a significant expansion of the rights of public interest groups to demand judicial review. However, few mechanisms exist to reduce financial barriers to environmental justice (WRI, 2016).

Provincial and local governments support local environmental organisations and volunteer programmes promoting environmental education, particularly in the area of biodiversity conservation. The federal government also provides methodological support for environmental education in schools. However, many initiatives to integrate environmental and sustainability aspects into school curricula in the provinces come from civil society rather than government. About half of Canadian universities have an environmental or sustainability policy, covering both operations and educational initiatives, but the situation is uneven across sub-national jurisdictions.

Recommendations on environmental governance and management

- Enhance institutional collaboration between the federal and provincial/territorial governments to reinforce synergies and reduce duplication of environmental management responsibilities, for example by extending provincial-territorial environmental framework agreements to areas requiring better cross-jurisdictional collaboration such as biodiversity conservation, water management, environmental assessment or land-use planning; expand the involvement of municipalities in vertical policy co-ordination; improve data management to better support decision making.
- Improve implementation of SEA at the federal level and introduce SEA requirements at the provincial level; ensure its application to regional and local land-use plans to better evaluate and address cumulative environmental effects of economic activities; enhance municipal capacity for land-use planning.
- Strengthen environmental assessment at the federal level by increasing transparency of the EA procedure and starting it at the early project design phase; ensure closer integration between EA and permitting at the provincial level.

Recommendations on environmental governance and management *(cont.)*

- Implement integrated environmental permitting in all sub-national jurisdictions; promote the use of best available techniques through a holistic, cross-media approach to setting permit requirements; expand the use of sector-specific standardised requirements and simplified permitting regimes for facilities with low environmental risk.
- Expand the use of administrative fines (instead of criminal penalties) for minor environmental violations; take account of economic benefit from non-compliance in determining the size of monetary penalties; develop enforcement policies with clear guidance on applying administrative and criminal sanctions proportionately to the seriousness of non-compliance; develop outcome-focused performance measurement of compliance assurance activities; ensure public disclosure of all enforcement data.
- Improve the procedure for consultation with Indigenous communities by starting engagement at the outset of the process; build their capacity to meaningfully participate in environmental decision making, particularly EA; clearly define and implement the concept of Indigenous communities' "free, prior and informed consent" with regard to land use and natural resource management.
- Enhance the quality and timeliness of information provided to the public; expand mechanisms to offer financial support for legal costs to facilitate access to justice on environmental matters; enhance the support for environmental education in secondary schools and universities.

3. Towards green growth

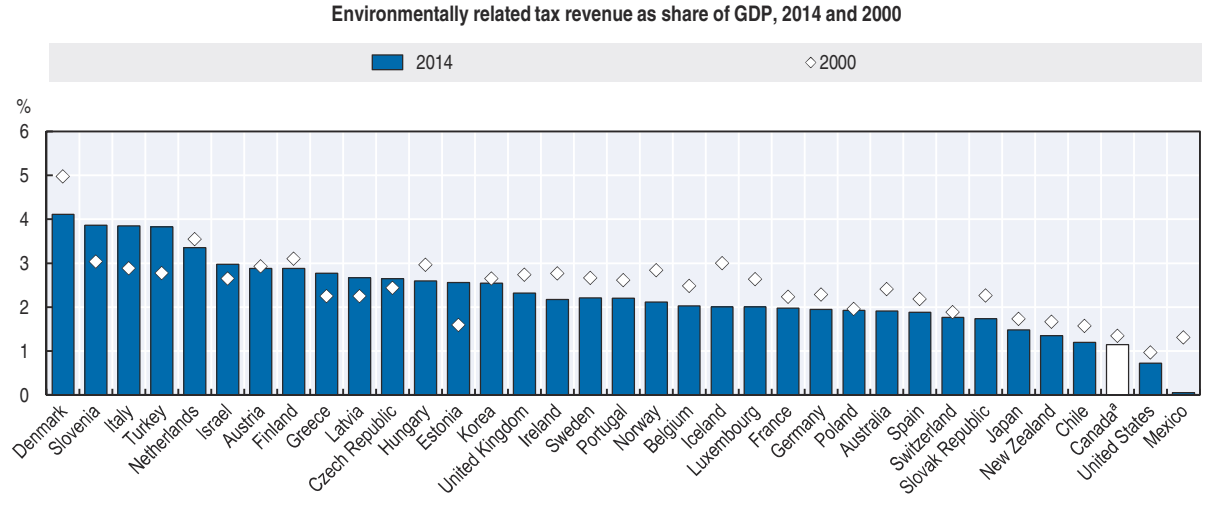
Canada has strengthened its commitment to "clean" growth and begun to build a strong policy framework for its delivery. Since 2008, a Federal Sustainable Development Strategy (FSDS) is required by law every three years. The FSDS is developed under the leadership of the Minister of the Environment and Climate Change with the involvement of more than 30 federal departments and agencies. The current FSDS (2016-19) improves upon previous versions by establishing concrete goals linked to the UN Sustainable Development Goals, and by defining measurable targets and responsible ministers across multiple federal departments. The involvement of Indigenous communities is included directly in several of its goals and targets. To date, the FSDS has focused on environmental aspects of sustainable development. Planned legislative revisions will provide an opportunity to address socio-economic challenges more explicitly. Several sub-national jurisdictions have their own sustainable development strategies or green growth plans. These are not directly linked to the FSDS and vary in their approach and comprehensiveness.

The 2016 Pan-Canadian Framework for Clean Growth and Climate Change (PCF) provides Canada's first-ever overarching plan to meet its GHG emissions reduction target in a co-ordinated manner among federal, provincial and territorial levels. In addition to advancing climate change mitigation (Section 4), the PCF aims to build resilience to climate change, as well as accelerate innovation, support clean technology and create jobs. The PCF is a promising first step in Canada's transition towards green growth, but many components are still being put into action. Rigorous implementation, combined with mechanisms for policy evaluation and adjustment, will help ensure Canada achieves its objectives.

Greening taxes and subsidies

Canada has made significant progress on carbon pricing in recent years. Carbon taxes or cap-and-trade systems are now in place in the four most populous provinces. Most of the remaining provinces have committed to introduce carbon pricing under the umbrella of the PCF (Section 4). While this is a significant achievement for Canada, there is scope to make greater use of environmental taxes. Revenues from environmentally related taxes decreased to 1.1% of GDP in 2014, the third lowest share in the OECD (Figure 2). Raising environmental taxes provides an opportunity to lower taxes that may be a brake on growth, such as taxes on corporate and labour income. It may also help finance new public investment, for example in innovation and in infrastructure.

Figure 2. **Canada has among the lowest levels of environmentally related tax revenue across the OECD**



a) Data include federal and partial provincial data.
Source: OECD (2017), "Environmental Policy Instruments", *OECD Environment Statistics* (database).

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Energy taxation, which accounts for most environmentally related tax revenue, has not been consistent with environmental and other external costs of energy production and use. Federal excise taxes apply only to transport fuels, with low tax rates by international comparison. Energy used for purposes other than transport (e.g. for electricity generation, industrial processes, or residential and commercial heating) is taxed at the provincial level, though taxes vary in scope, level and characteristics. The combination of the narrow tax base and low tax levels placed Canada among the three OECD member countries with the lowest effective tax rate on energy use in 2012, both in terms of energy content and carbon content. This represented foregone revenue and reduces the incentive to save energy and switch to cleaner forms of energy supply. The expansion of carbon pricing under the PCF (Section 4) will, however, help the country catch up with OECD peers. It will increase the effective carbon taxation rate on CO_2 from energy use and, importantly, expand its coverage to sectors other than transport.

The only tax that applies at the federal level to electricity consumption and fuels used to produce electricity is the federal value-added tax. In addition, most provinces regulate electricity prices, and generally keep them low. The phase-out of coal in Ontario seems to

have contributed to an increase in electricity prices that, viewed from an international perspective, is rather small. Electricity prices in Ontario and in Canada generally remain among the lowest in the world, yet the price increase remains controversial for some. Low electricity prices act as a barrier to energy efficiency measures and renewable energy development, but governments have preferred targeted subsidies, regulated requirements or information instruments over price increases.

Canada's transport-related taxes and charges could be adjusted to have greater influence in preserving the environment. For example, the federal excise tax on the purchase of fuel-inefficient vehicles does not apply to pickup trucks. Yet these trucks are among the best-selling vehicles in Canada and their GHG emissions have been rising continuously. The tax essentially applies only to luxury passenger vehicles, providing no incentives to purchase high-performing vehicles in other categories. As in most OECD member countries, diesel is taxed at a lower rate than petrol, despite its greater carbon content per litre and greater environmental harm from certain air pollutants. Diesel for commercial use is taxed at an even lower rate (IEA, 2017). Most governments do not link vehicles' emissions or fuel economy performance with their vehicle registration charge. There is thus no incentive to opt for a more environmentally-friendly vehicle. Some cities and provinces have introduced limited congestion and road pricing. In other jurisdictions, such as Ontario, legislation and policy have prevented their introduction. Canada's transport-related taxes and charges are due for review, considering new developments in carbon pricing, the proposed federal clean fuel standards and possible changes in US vehicle standards.

Some progress has been made in pricing water use, generation and disposal of waste, and water and air pollution. Some cities have shifted towards volume-based and full cost-recovery pricing in urban water supply and some regions facing water scarcity have introduced water trading (e.g. southern Alberta). Ontario and Alberta have long used cap-and-trade systems to manage NO_x and SO_x emissions, while Quebec has introduced some water pollution taxes. However, for the most part, Canada relies on regulation to address air and water pollution. Canadian governments should more rigorously consider the use of economic instruments as a lower-cost alternative to regulation.

Canada has made progress in reducing environmentally harmful subsidies, but more work remains at the provincial level. Between 2005 and 2014, fossil fuel support was reduced by almost half. This was in part due to the removal of Ontario's sales-tax exemptions for energy products. The reduction was also influenced by federal reforms relating to the treatment of certain capital expenses for oil sands and coal mining. Yet, according to the OECD Inventory of Support Measures for Fossil Fuels, some CAD 3 billion in fossil fuel support per year remains. The bulk of this support stems from provincial and territorial measures (such as royalty reductions, tax credits for drilling and tax exemptions for fuel use in farming and fishing). To make further progress, sub-national governments will need to be brought into discussions on reducing fossil fuel subsidies. Public revenue from royalties and land sales from the oil and gas sector continues to come mainly from conventional oil and gas development, even though oil sands production now exceeds conventional production. Subsidies to agriculture have been reduced to levels that are among the lowest in the OECD (measured as percentage of gross farm receipts). However, 70% of remaining support is in the form of price support. This risks encouraging production and increasing associated GHG emissions and pressures on water and biodiversity.

Expenditure and investment

Canada does not systematically track public environmental expenditure across jurisdictions and ministries. Business environmental expenditure seems to have increased in most recent years. Most of these expenditures focus on pollution control within the oil and gas, and mining and quarrying sectors.

Investment needs for infrastructure are large. An estimated 30% of municipal infrastructure, a sector that represents 57% of Canada's core public infrastructure, is in fair or poor condition; an estimated CAD 141 billion is needed to replace infrastructure in poor condition (FCM, 2016). Some of the biggest gaps include environment-related infrastructure, such as public transit, buildings and wastewater. The federal government has recently embarked on a major initiative to support provincial and municipal investments in infrastructure, including for public transit and green infrastructure. To ensure highest value for money, Canada would benefit from pursuing a more strategic approach to project selection than it has used in the past. Specifically, it could consider objectives and priorities in an integrated manner rather than slotting projects into distinct envelopes of funding. In addition, clearer guidance on project approval and design criteria across all infrastructure projects could help ensure that any investment is climate-resilient and contributes to Canada's low-carbon and clean growth vision. A May 2017 announcement by the Minister of Infrastructure and Communities makes progress in this regard. Local, provincial and territorial governments must now apply a "green lens" to proposed infrastructure projects before they can be approved for federal funding. An emphasis would be put on GHG reductions and climate resilience to reduce the cost of disasters on communities.

Public-private partnerships have been used increasingly over the past decade, notably in the water, wastewater and solid waste management sector. The federal government is seeking additional opportunities to leverage private sector investment. Some institutions are using green bonds, including Canada's export credit provider and the governments of Ontario and Quebec. The recently announced Infrastructure Bank could play a role in co-ordinating and consolidating green bond initiatives across the country, for example by establishing common standards and definitions, and encouraging a larger pool of bankable projects.

Eco-innovation, green markets and employment

Canada's innovation environment has some strong elements, with a good skills foundation, high-quality university-centred research and a generous tax regime for research and development (R&D). However, the level of public investment in R&D, measured as a share of GDP, is relatively low. Indeed, it has been declining since 2000. In line with recommendations from the OECD, as well as Canada's own innovation task force, the federal government has begun to shift away from the use of R&D tax credits towards competitive and transparent grants better suited to the needs of young firms. A relatively large share of public R&D expenditure targets the energy sector (8% of total R&D budget). This reflects large investment in oil sands, but also in environmental management improvements (e.g. water reuse) and carbon capture and storage (CCS). About 4% of total public R&D outlays target the environment, in line with the OECD average. However, the share of energy-related R&D supporting renewable energy and energy efficiency is among the lowest in the OECD. Environmentally related patent applications have increased since 2000, albeit at a significantly slower pace than in leading OECD member countries. On a per capita basis, Canada files far fewer green patents than leading OECD member countries.

The lack of domestic demand and markets for clean technologies and solutions has been reported as a major barrier to eco-innovation in Canada. The country's share of the global clean technology market fell between 2005 and 2014. However, green markets seem substantial, with Statistics Canada estimating revenues from environmental goods and services at CAD 4.1 billion in 2012. Other sources, which include revenues from small and medium-sized enterprises (SMEs), estimate revenues from Canada's clean technology industry at CAD 13.3 billion in 2015, exports of CAD 6.7 billion and employment of 55 200 (AA, 2017). The federal government committed to improve national statistics on the sector by including a broader range of technologies and a clear definition of Canada's clean technology sector. It also plans to establish a baseline in order to track the contribution of the sector to GDP and employment.

The recently announced federal Innovation and Skills Plan includes clean technology and clean resources as two of the six areas of focus. In addition, the government has committed to double investments in clean energy research, development and demonstration (RD&D) by 2020 from 2015 levels under Mission Innovation. These intentions are most welcome as a number of Canadian sectors need accelerated innovation to achieve green growth. The 2017 federal budget further proposed CAD 1.4 billion in new equity financing, working capital, and project financing to support clean technology. In the area of CCS, Canada has been an early leader: it developed two major pilot projects through demonstration funding and R&D supported by both federal and provincial governments. To ensure the effectiveness of new funding, the federal government has proposed establishing the Clean Growth Hub to streamline innovation support mechanisms across organisations and support a new Innovation Canada single-window platform. A PCF federal-provincial-territorial working group will also support co-ordination and implementation of clean technology commitments across Canada. A greater role for the private sector in eco-innovation should be encouraged. This is particularly the case in sectors where the carbon price will be insufficient to induce the near-term innovation needed to achieve long-term environmental objectives. Some positive examples of collaboration to tackle eco-innovation challenges include the Canadian Oil Sands Innovation Alliance (COSIA) and the Bio-pathways Partnership Network for Canada's forestry sector. These could serve as models for collaborative approaches in other sectors of the economy.

Strengthened environmental policy instruments, such as carbon pricing, the development of green procurement, greening government operations and eco-labelling initiatives will help increase domestic demand for eco-innovation and environmental goods and services. Energy efficiency regulations and minimum standards are also important tools to foster eco-innovation. With Canada part of the large, integrated, North American energy market, there are economic opportunities from market-wide standards for clean technologies and products.

Distribution issues and competitiveness impact of the green growth transition

Electricity and petrol prices are relatively low compared to other OECD member countries. However, if not adequately addressed, concerns about the impacts of green growth policies on these prices, as well as on business competitiveness, could derail ambitious environmental plans. Most provincial carbon pricing policies are building mechanisms to minimise impacts on vulnerable households and businesses. Some, for example, recycle carbon pricing revenues and/or develop complementary or alternative measures for certain emitters. Care must be taken that any support measure preserves the price signal that encourages more environmentally beneficial choices and behaviour to the greatest extent

possible. While targeted adjustments to green growth policies for businesses may be justified in some cases (for example, for emissions-intensive trade-exposed industries for which no effective abatement technologies are available), such protective measures should be gradually phased out.

Canadians also have opportunities to better capture the benefits of a green growth transition. Until recently, Canada has not linked green skills needs with its broader skills policy agenda. The new Innovation and Skills Plan, however, offers an opportunity to better incorporate analysis of the green skills needs across skilled trades and academic disciplines. The green growth transition also has potential to reduce the vulnerability of Indigenous peoples to environmental impacts, such as climate change and poor water quality. At the same time, the transition could help them capture employment opportunities in areas such as renewable energy or protected area expansion.

The international dimension of green growth: Multilateral efforts, trade and development co-operation

Canada's withdrawal from the Kyoto Protocol in 2011 and the UN Convention to Combat Desertification in 2013 left it open to international criticism. However, the government elected in 2015 has injected new energy into international engagement on the environment. Canada re-joined the UN Convention to Combat Desertification and ratified the Paris Agreement on climate change. It is also engaged in a number of other international partnerships, including the Climate and Clean Air Coalition, the Arctic Council Expert Group on Black Carbon and Methane, the Global Methane Initiative, the Convention on Long-range Transboundary Air Pollution and the Carbon Pricing Leadership Coalition. While the United States' decision not to implement the Canada-US commitment to reduce methane emissions from the oil and gas sector is a setback, Canada should continue to press forward, pursuing the most cost-effective approaches possible along with measures to mitigate competitiveness concerns.

Canada has increased the proportion of official development assistance (ODA) that is environmentally-related from 6% in 2007-08 to more than 31% in 2013-14. In part, the increase reflects commitments within the international climate change negotiations. Canada assesses all of its development assistance activities for potential environmental sustainability risks and opportunities, particularly in relation to climate change, land degradation, access to clean water and sanitation, and urbanisation. It is also among the OECD leaders in incorporating environmental considerations and obligations in its free trade agreements. Canada is one of the few OECD member countries to enact legislation that makes it obligatory to assess potential environmental impacts of trade agreements. Canada has signed a number of agreements on the environment and established environmental co-operation mechanisms with various countries. The Canada and European Union Comprehensive Economic and Trade Agreement, for example, includes a trade and environment chapter.

Recommendations on green growth

Policy frameworks to support green growth

- Ensure effective and timely implementation of the Federal Sustainable Development Strategy and the Pan-Canadian Framework on Clean Growth and Climate Change, combined with mechanisms for policy evaluation and adjustment, while more explicitly addressing the social component of sustainable development; ensure that sectoral policies, notably energy policies, are well aligned with both frameworks.

Recommendations on green growth *(cont.)*

Green taxes and other market-based instruments

- Resist pressure to halt or alter carbon pricing plans due to competitiveness concerns, instead focusing on measures to mitigate those concerns through policy design, revenue recycling and programming targeted at vulnerable sectors; include carbon pricing impacts on businesses, work forces and households in commissioned expert assessments.
- Review the taxation of energy use, taking into account the gradual roll-out of nation-wide carbon pricing, and adjust as necessary to ensure that energy prices adequately reflect the societal costs of GHG and air pollutant emissions; gradually reduce the petrol-diesel gap and increase diesel taxes for commercial and residential use; reform the tax on fuel-inefficient vehicles to optimise incentives for the purchase of lower emission vehicles across all categories.
- Continue to review and adjust tax, royalty and subsidy regimes that encourage fossil fuel production in order to meet Canada's commitment to rationalise and phase-out inefficient fossil fuel subsidies that encourage wasteful consumption by 2025; provincial governments in particular need to make further progress; ensure that Crown royalty and land sale payments are not more favourable for unconventional development than for conventional.

Investing in environmental infrastructure and services

- Pursue a more strategic approach to project selection for infrastructure investment and develop priority lists for infrastructure projects that deliver multiple objectives in partnership between the federal government and provinces, territories and municipalities; ensure cost-benefit analysis of infrastructure projects consider environmental externalities, such as GHG emissions; use the Canada Infrastructure Bank to ensure greater co-ordination and standardisation in green bonds and other tools aimed at leveraging private sector investment in environmental infrastructure.

Promoting eco-innovation and green markets

- Provide stable and higher public investment in R&D; shift away from indirect tax credits towards competitive and transparent grants; ensure that energy-related R&D focuses on reducing and mitigating environmental impacts from fossil fuel activities, rather than encouraging increased oil and gas production; ensure innovation programming extends to renewable energy and energy efficiency and the circular economy.
- Foster domestic demand for clean technology and eco-innovations through public procurement, fiscal incentives and information sharing; improve federal-provincial-territorial collaboration to improve access to financing for Canadian clean technology firms; encourage a greater private sector role in research, development and technology adoption.

The social consequences of the transition towards green growth

- Ensure that measures to mitigate the distributional impacts of green growth policies preserve the price signal reflecting negative externalities and are narrowly targeted towards vulnerable households.
- Position Canadians to capture the benefits of green growth by better integrating green skills needs into existing and new skills and training policies, addressing both skilled trades and academic disciplines.
- Fulfil commitments to Indigenous communities to work with them to reduce their vulnerability to climate change and poor water quality, while supporting and encouraging efforts to capture income and job opportunities for them from green growth in areas such as renewable energy and protected area management.

Recommendations on green growth *(cont.)*

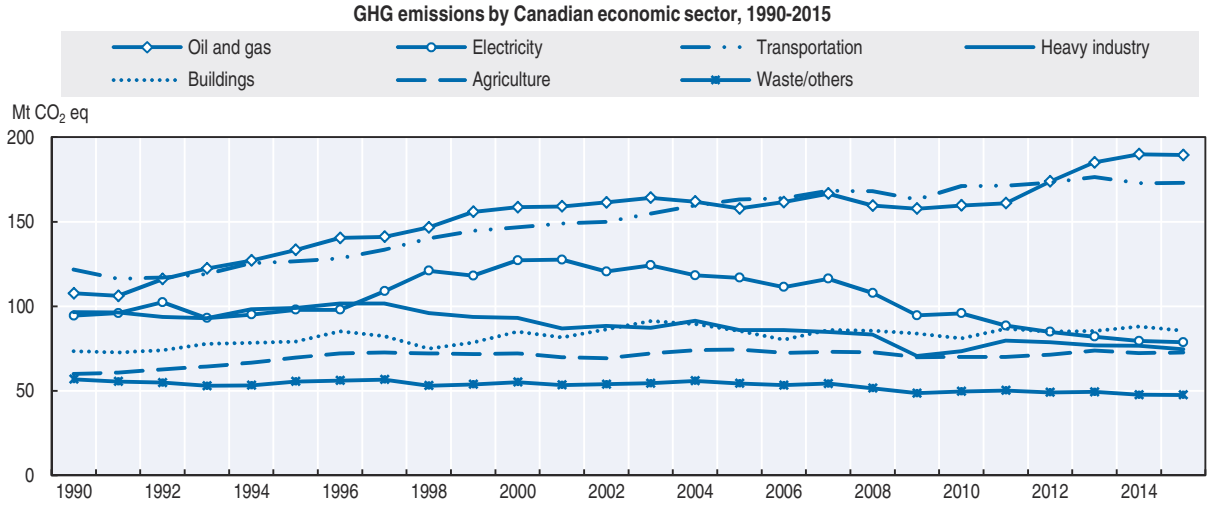
The international dimension of green growth: Environment, trade and development

- Maintain Canada's engagement in international environmental agreements and expand environmentally related development assistance, while pursuing new agreements and partnerships as part of trade agreements with the aim of promoting a level playing field for business, expanding knowledge-sharing and improving environmental outcomes.

4. Climate change mitigation in electricity generation and transport

Ten years after the last *Environmental Performance Review*, Canada's total GHG emissions are almost 20% above the 1990 level and have fallen back only slightly compared with the 2005 level. Two large provinces (Ontario and Quebec) and some of the smaller provinces and territories have reduced their emissions compared to the 1990 level, but others did not. Emissions in electricity generation have been cut quite significantly. However, they grew substantially in domestic transport and in the oil and gas extraction industry – the two largest emitting sectors in absolute terms (Figure 3).

Figure 3. **GHG emissions from transport and oil sands kept rising**



Note: Excluding emissions from Land Use, Land-Use Change and Forestry (LULUCF) sector.
Source: ECCC (2017), *National Inventory Report 1990-2015.*

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While Canada did not develop an explicit nation-wide mitigation strategy, several provinces moved ahead with ambitious climate policies, including various schemes of carbon pricing. British Columbia has a carbon tax; Quebec has a joint cap-and-trade system with California that Ontario, which launched a cap-and-trade programme in 2017, is planning to join in 2018; and Alberta has a hybrid system that involves emission intensity targets for major emitters, with offset trading between under- and over-performers, combined with a carbon levy elsewhere in the economy. The cost of emissions varied between CAD 18-30 per tonne of CO_2 in early 2017. This is low compared with what is needed to get near the 2°C target. Nevertheless, it is higher than in most of the carbon pricing or trading systems in the rest of the world. Several additional measures have been introduced at the provincial level, including incentives and regulations targeting specific activities and sectors.

Mitigation under the Pan-Canadian Framework for Clean Growth and Climate Change

The Pan-Canadian Framework for Clean Growth and Climate Change (PCF) is a well thought-out strategy. It aims to ensure that all jurisdictions in Canada are striving for GHG emission reductions that are consistent with the national target, building on progress that different provinces and territories have already made. A key component is the introduction of pan-Canadian carbon pricing. Complementary measures include the phase-out of coal-fired electricity production and the development of clean fuel standards for fuels used in transport, industry and building. While the PCF target leaves Canada's emissions not much below previous commitments (Figure 1), it remains ambitious given the country's current and foreseeable emissions profile. The target implies that Canada needs to achieve drastic reductions between 2030 and 2050 to be consistent with the internationally agreed objective to keep global warming within 2°C. Canada's Mid-Century Long-Term Low-Greenhouse Gas Development Strategy, issued in 2016 as a discussion document, outlines an emissions pathway involving emissions 80% below the 2005 level by 2050, which implies a cut between 2030-50 nearly twice that planned for 2014-30.

Successful implementation of Canada-wide carbon pricing will be key for the country to meet its climate objectives. The PCF sets a federal "benchmark" carbon price of CAD 10 per tonne of CO_2eq in 2018 with a commitment for it to rise to CAD 50 per tonne by 2022. Special conditions may apply for emissions-intensive, trade-exposed industries to address competitiveness concerns. For jurisdictions with cap-and-trade regimes, it requires a decline of annual caps that corresponds with projected emission reductions from the carbon price in price-based systems (e.g. a carbon tax). If provinces and territories do not meet the benchmark or choose to not introduce their own carbon pricing regime, the federal government will introduce a federal carbon pricing system with revenues returned to the jurisdiction. All jurisdictions have signed on to the PCF except Manitoba and Saskatchewan. Saskatchewan has threatened to take the federal government to court if it imposes carbon pricing in the province.

By setting a federal (minimum) level of ambition while leaving provinces flexibility for implementation of their carbon pricing policies, the PCF accommodates existing systems. It also provides latitude for considerable policy experimentation. Practical implementation will, however, be a huge challenge. Much work will be needed to understand how the benchmark carbon price will apply in Alberta's hybrid system or Quebec and Ontario's cap-and-trade system, while ensuring some sort of level playing field from a competitiveness perspective. Indeed, there are differences in the coverage and price levels, and of policy effectiveness, across jurisdictions. These may eventually create frictions and pressures for eventual convergence of the different pricing systems to reduce costs, improve efficiency and address business competitiveness concerns. The linkage of the Quebec-Ontario-California cap-and-trade system presents another challenge. No agreement has yet been reached at the national level as to whether emissions reductions (compliance units) in California purchased by Quebec, for example, would count towards Canada's Paris Agreement mitigation target.

An initial step towards "convergence" of carbon pricing could be to link existing systems through a common offset scheme. An emitter in one jurisdiction, for example, could acquire offset credits from projects not covered by trading or carbon tax systems in other jurisdictions. Emitters in carbon tax jurisdictions could use the offsets to reduce their calculated emissions for tax payment. Offset provisions already exist in jurisdictions with

pricing regimes. However, regimes in Alberta and British Columbia have been developed independently. As a result, they use different offset protocols and approaches to verification and monitoring than Quebec and what is being proposed in Ontario. A common offset scheme would need to ensure that the credits are additional, verifiable, permanent, measurable and enforceable. Such a step would allow for arbitrage across systems, lowering the overall cost of any given level of national emission reduction.

Establishing a clear commitment to, and a timeline for, an increasing carbon price (and steady tightening in cap-and-trade systems) after 2022 will be crucial to reduce uncertainty for investors and project developers, and to induce a change of behaviour as soon as possible. The announcement in advance that the price will rise to CAD 50 in 2022 is welcome; not many countries have yet made such a step. Notwithstanding, it remains very low compared with current abatement costs and Canada will need to go further. Similarly, coverage of carbon pricing systems should gradually increase. Under current plans, the carbon price would apply to between 70-80% of total emissions. This is a higher share than under the European Union Emissions Trading System, for example. However, the long-term ambition should be to ensure no significant emitters are exempt and that its coverage is as wide as possible. Various grandfathering or free allowance provisions (used, for example, in Quebec and Alberta) can be important when pricing is first introduced, both to give firms time to adjust and to gain acceptance. However, they will need to be phased out in the longer term.

Canada should establish a strong accountability mechanism that would allow for tracking and comparing progress across provinces. A "feedback rule" could be adopted, determining the path for the backstop carbon price by a commitment to accelerate price increases if it becomes clear that Canada's emissions are not falling as intended. This would mimic one useful property of cap-and-trade systems without being rigidly bound to specific targets. A feedback rule could also be applied to policies other than carbon pricing, for example by pre-announcing that regulations will be tightened (or relaxed) as a function of the current and expected path of GHG emissions. The assessment whether existing policies are likely to lead to intended outcomes, and whether, a priori, overall tightening is needed to keep GHG emissions on track, should be conducted by an independent body. The process should build on monitoring and evaluations mechanisms and institutions already in place. Reports of the Auditor General of Canada, such as those on progress in implementing Federal Sustainable Development Strategies, could serve as a possible model. Such assessments could also review the effectiveness and efficiency of the policy mix, which may change as the carbon price enters into effect or increases.

Energy and climate objectives will need to be balanced, and their respective policies better integrated. For example, the Canadian Energy Strategy, which the premiers of Canada's provinces and territories agreed on in 2015, does not integrate effectively the implications of decisive action on GHG mitigation on the energy production sector in Canada. New oil pipelines are planned to connect Alberta's oil sands to the United States and Canada's Pacific harbours. These will likely create production and export capacity inconsistent with Alberta's recently announced cap on GHG emissions of 100 million tonnes from oil sands, or Canada's national mitigation goal more broadly. The federal government aims to reduce methane emissions from energy production by 40-45% below 2012 levels by 2025. This objective would benefit from tighter regulatory environment to better address venting and flaring and ensure data transparency. Recent research suggests that methane emissions from the oil and gas industry are significantly higher than previously thought, reflecting inappropriate technology or poorly maintained or monitored devices (Pembina

Institute, 2015; Environmental Defence Canada, 2017). The Canadian Energy Strategy needs updating to clarify the energy sector's contribution to the transition to a low-carbon economy. It should also take into account Canada's large potential to improve energy efficiency in buildings, heating and electricity retail. The PCF includes a number of proposals for action in this area.

Finally, evaluation of any policy, programme or major investment project should take into account its impact on GHG emissions. This would improve consistency across the range of public policies and projects. One way of achieving this is to introduce GHG emissions, valued at the overall carbon price (and taking into account its likely increase through time), into impact and cost-benefit analyses. Most fossil fuel subsidies, for example, would be unlikely to survive such a test. Policies to reduce methane and other non-CO_2 gases, where direct pricing seems impracticable, can be assessed with a carbon-equivalent price set on their impact on emissions.

Mitigation in electricity generation

Canada's electricity generation is among the least carbon-intensive in the OECD and the sector contributes to a rather small share of national GHG emissions (11% in 2015). However, around 40% of emissions reduction in 1999-2016 came from measures related to electricity generation (ECCC, 2016c). The PCF identifies several measures to achieve further emission reductions. These include increasing the amount of electricity generated from renewable and low-emitting sources; connecting clean power with places that need it; modernising electricity systems; and working with Indigenous peoples and northern and remote communities to reduce their reliance on diesel. A number of governments have also implemented relevant policies, including renewable portfolio standards. Some are moving towards large competitive procurement to deploy more renewables.

The demand for electricity will rise substantially up to 2050 as fossil-fuel use in transport, homes and industry declines. Improving energy efficiency and using Canada's vast untapped renewable energy potential can play a vital role in meeting future demand, while advancing decarbonisation of the power sector and maintaining affordable energy prices. However, low electricity prices (Section 3) have acted as a barrier to both energy efficiency measures and renewable energy development. Canada's low energy prices are a key competitive advantage. However, they should be based on genuine resource availability, not under-pricing of externalities, implicit subsidies or skimping on infrastructure maintenance and investment. In addition to well-aligning prices to costs, "nudging" policies can help consumers make good decisions, especially for long-lived items like home heating, insulation and many appliances. Canada's energy labelling schemes help in this way. Research into their effects and of other measures such as smart home meters can enhance their effectiveness.

Additional generation capacity required to meet future demand needs to be developed in ways that minimise environmental costs, while ensuring reliable energy supplies across the country at reasonable cost. Expanding generation from natural gas, wind and hydro power are all plausible candidates at the moment. Other emerging sources of generation could also be deployed, including geothermal and offshore marine renewable energy (e.g. wind and tidal). Coal-fired generation could also remain economical for longer than expected if carbon capture and storage (CCS) technology can be sufficiently effective. Canada hosts two of the world's first large-scale CCS facilities, including the Boundary Dam power station in Saskatchewan. These projects should be used to gain knowledge on the economic costs and environmental results of the technology, and assess its potential future role.

The balance between the location of demand for electricity and of its supply will shift; good sites for new hydro-generation and wind will not always be found close to where the energy is needed. This will require substantial investment in transmission infrastructure. Provinces such as Alberta and Saskatchewan, which have been self-sufficient in energy, may find themselves net importers of hydro. Infrastructure investments through the PCF are intended to support transmission investments. These will be identified by provinces and territories through a consultation process led by the federal government, which is currently underway. Wind and solar photovoltaic power require investment of a different sort – in storage or backup facilities to cope with the inherent variability of these sources, smart grids and demand management.

Realistic costing of the different options, including full pricing of GHG emissions and associated investment in infrastructure, is necessary. Direct subsidies for renewables may eventually become redundant with GHG pricing in place (especially if under a cap-and-trade system). However, contract design may need to be adapted if wind or solar grow substantially: a large share of capacity with low marginal cost, but high capital costs and intermittent availability, changes the economics of supply. Payment for capacity availability, as well as electricity actually delivered, is needed, along with clear information on future regulation (including the price of carbon).

Wind and hydroelectricity technologies are both well-developed in North America. They do not face any particular barriers to investment that other technologies do not also face. If, for example, subsidies are used because of other (non-GHG) benefits from renewable generation, they can be designed to minimise costs rather than guarantee returns or prices. One example is through reverse auctions (or bid-to-supply), like the recently announced competitive process in Alberta. Transparency in the whole process should help the public understand the issues and help them see why some increases in electricity prices are likely and necessary.

Mitigation in the transport sector

Introducing effective policies faces particular challenges in Canada, where geography and historically low energy prices have led to a spatial structure heavily dependent on transport. Dispersed settlement patterns and low density urban structure make passenger transport a necessity rather than a luxury. They also render the use of some measures, such as increased public transport, more difficult or costly. A key consideration is the integration of the Canadian and US markets in vehicles and transport services. This constrains Canada's ability to run different policies from the United States as regards vehicle regulations and fuel taxation, for example.

Emissions from transport accounts for about one-quarter of Canada's GHG emissions, and three-quarters of this comes from road transport. The rate of increase from transport emissions has slowed as a result of various federal and provincial policies. These include federal GHG emission regulations for new on-road vehicles, provincial and federal renewable fuel standards, and investments in public transit infrastructure. However, emissions from transport have continued to grow since 2000.

Further GHG emission reductions could be achieved by expanding the use of natural gas and biofuels for freight and passenger transport, increasing the penetration of zero-emission vehicles in urban areas and by progressively shifting public transport towards more efficient modes (e.g. bus and rail). The PCF includes plans for federal-provincial-territorial

collaboration to make progress in all of these areas. Over time it will be important to identify which of these policies are the more cost-effective. Care should be taken to identify and address interactions between different instruments, such as between a rising carbon price and tighter emissions regulations. Policy measures should be well-focused on desired outcomes, taking into account other externalities, such as air pollution, congestion and accidents.

Canada offers strong monetary and non-monetary incentives for zero-emission vehicles. Manufacturers are able to give additional weight to battery electric, plug-in hybrid and natural gas vehicles when calculating compliance with fleet average emission standards. The provinces of Ontario, Quebec and British Columbia also provide financial incentives to encourage citizens to purchase electric vehicles. Such incentives help get new technologies off the ground. The advantageous treatment of electric and natural gas vehicles when calculating compliance with fleet average emission standards will be reduced over the next few years. Provincial purchase incentives are regularly reviewed and revised by the respective governments. This is a good practice given the risk of excessive costs. Different strategies are likely required for commercial freight and public transport vehicles from those required for personal transport.

In a competitive commercial sector, incentives through fuel costs are likely to be effective. Strong vehicle standards are important to enhance the impact of pricing. In the rail and aviation industries, fuel costs amount to around a quarter of total operating costs, similar to labour costs. Saving 10% on fuel costs may increase profits by a similar percentage. Companies operating in a competitive market are likely to react much more strongly to this incentive than private car owners. Voluntary agreements between industry associations and the government have contributed to significant improvements in fuel efficiency in the rail and aviation industries. For public passenger transport, where competition may be limited, decisions on infrastructure investment and service provision need to be based on cost-benefit analysis. They must also be integrated into spatial planning decisions.

Recommendations on climate change mitigation

Recommendations on general climate change policy

- Develop an institutional mechanism for monitoring and evaluating the implementation of climate change policy under the PCF and their contribution to meeting GHG emission targets; consider introducing mechanisms for adjusting policies over time in order to meet policy goals. One possibility is to give responsibility to the Office of the Auditor General of Canada, in collaboration with provincial audit offices.
- Implement carbon pricing in all jurisdictions; ensure that exemptions or other measures to smooth the transition for businesses are temporary and limited to emissions-intensive trade-exposed industries with limited effective abatement options; work towards increasing the share of emissions covered by a carbon price and plan for progressive tightening; identify and address interactions of carbon pricing and complementary regulations, both at the federal and provincial/territorial level.
- Promote co-ordination of sub-national climate policies and schemes and encourage linking between sub-national pricing systems, even if only at the sector level; consider the introduction of an inter-jurisdiction offset scheme to help meet nation-wide targets more efficiently. Such work could provide a foundation for a possible future transition to a full national cap-and-trade or carbon taxation system.

Recommendations on climate change mitigation *(cont.)*

- Ensure that energy policy is aligned with climate change policy and other environmental goals, including with respect to future energy supplies (especially the role of renewables), grid interconnections across Canada, and demand management through pricing and energy efficiency standards; swiftly implement available energy efficiency measures and phase out fossil fuel subsidies; tighten the target and implement regulation to reduce methane emissions from energy production without further postponement, possibly aligning regulation to the tightest of regulations already in place in some US states, and improve monitoring and enforcement.
- Encourage use of the implied GHG price time path as a shadow price in policy and project evaluations, throughout government and public agencies.
- Design public education and information campaigns to enhance transparency and gain acceptance of policies and promote public support; monitor the impact of climate policy on vulnerable groups of society, ensuring that general policies for income support and welfare are well adapted to the possible impacts of climate change policies on income and employment, and that they cover all sections of the population including Indigenous peoples.

Recommendations on electricity generation

- Prioritise the elimination of fossil fuels while tapping into Canada's vast renewable energy potential; review and adjust specific support schemes for renewable energy to the trends in technology cost and carbon pricing. Where incentives beyond carbon pricing are needed, use market-based mechanisms such as reverse auctions for capacity to look for low-cost solutions.
- Ensure electricity pricing reflects full economic and environmental costs; complement pricing with information programmes like Energy Star, experimenting with other "nudging" measures to help consumers make effective use of information.
- Encourage the sharing of best practice of leading carbon capture projects across Canada based on assessments of cost and performance, including the facility at Boundary Dam in the power segment; follow through on inter-jurisdictional consultation to expand grid inter-connections to make better use of the potential for hydro storage to complement the increased variability of growing generating capacity for renewable energy.

Recommendations on transport

- Continue to drive the decarbonisation of transport by ensuring that environmental externalities from fossil fuel use are adequately priced, either through carbon pricing schemes or direct fuel taxation; encourage the increased use of renewable fuels, electrification of transport, use of natural gas, and mode switching, including by additional vehicle and fuel taxation measures, as well as regulation.
- Continue to promote the provision of information on vehicle fuel economy and GHG emissions, including by making the EnerGuide labelling system obligatory; ensure the labelling is based on independently verified information, and laboratory testing benchmarks are monitored to ensure they are representative of performance under real-life driving conditions.
- Promote road charging, congestion charging, parking policy and other measures that both reduce the use of private transport and associated GHG emissions, and other environmental externalities; build on the Smart Cities programme to highlight and disseminate good or innovative practices; design land use and spatial planning policies to enable future low-carbon cities.

Recommendations on climate change mitigation *(cont.)*

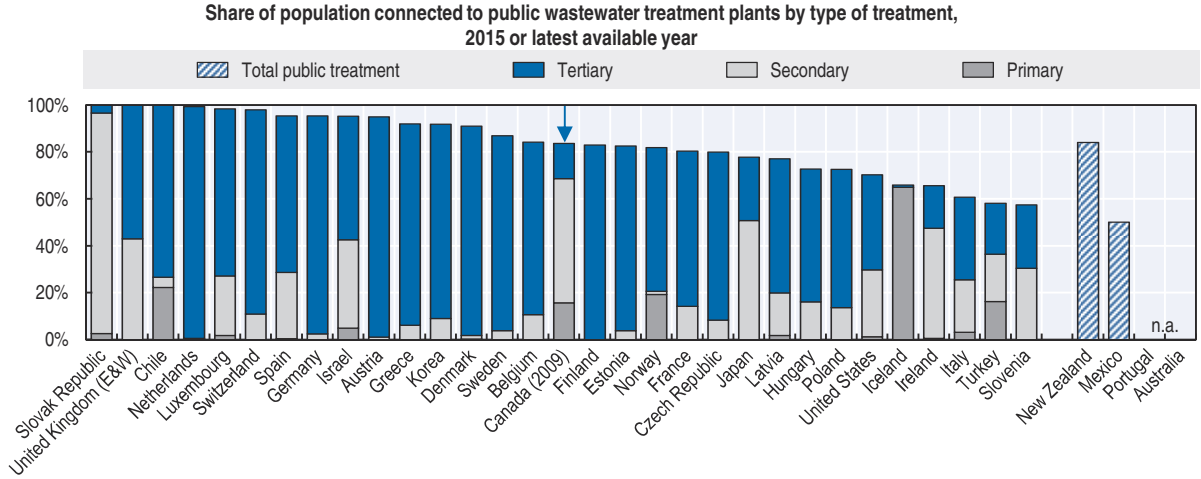
- Continue to enable the deployment of charging and refuelling infrastructure for low- or zero-emission vehicles, including by sharing information and lessons learned from pioneering municipalities, provinces and federal programmes to accelerate learning; and encourage standardisation and technology-neutral facilities to the extent possible.
- Benchmark and reduce energy use in the freight sector; encourage modal shifts in the freight sector, such as increasing the use of rail or water transport in place of long-distance heavy trucks; and encourage the development of associated infrastructure, but with appropriate cost-benefit analysis as a condition attached to public financing.

5. Urban wastewater management

Even though clean freshwater is abundant in Canada, resources are under pressure on various fronts. Competition to access the resource intensifies in densely populated areas, while urbanisation and agricultural activity put pressure on water quality. At the same time, climate change strains existing institutions (e.g. water allocation regimes) and infrastructure (e.g. for rainwater collection and treatment). Effluent from urban wastewater systems represents one of the largest sources of pollution by volume into Canadian waters, affecting aquatic ecosystems and water bodies.

Canadians generally benefit from reliable access to, and good performance of, wastewater treatment. However, a relatively large share of the population still relies on primary wastewater treatment, while a relatively small share is serviced by advanced tertiary treatment (Figure 4). The performance of treatment facilities remains limited or poor in some areas, including large metropolitan centres like Vancouver and Montreal. Adaptation of urban wastewater management to climate change is slow across the country. Only 16% of Canadian municipalities had formally factored climate change into wastewater management in 2016.

Figure 4. **Many Canadians rely on primary wastewater treatment**



Note: Includes preliminary data. Data earlier than 2010 have not been considered except for Canada.
Source: OECD (2017), "Water: Wastewater Treatment (% Population Connected)", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933565165

In Indigenous and northern communities, wastewater treatment often relies on ecosystem services, such as those supplied by lagoons, which discharge treated effluent into designated natural receivers. Sustained financial support from the federal government helped improve access of Indigenous communities to modern wastewater treatment systems. Still, more than half of wastewater systems in Indigenous communities are considered medium overall risk and 3% are considered high risk.

The impact of urban wastewater on water quality is not known with accuracy. Detailed assessments are not compiled at federal level. Monitoring varies across provinces, which partly reflects the size and diversity of the country, and the specificities of local situations. It makes a coherent assessment of the situation and prioritisation of responses cumbersome. New contaminants emerge as an issue of concern and may require more systematic action to build adequate monitoring and management capacity.

New federal regulation has strengthened the policy framework, yet implementation is slow

Over the last decade, the development of a national strategy and federal wastewater effluent quality standards has strengthened the policy framework for urban wastewater management. Provincial and territorial governments have primary responsibility for the management of wastewater treatment. Policy objectives, regulatory frameworks and instruments therefore vary widely across the country. The Canada-wide Strategy for the Management of Municipal Wastewater Effluent, endorsed by Environment Ministers in 2009, set out a harmonised framework for this issue.

Under the framework of the strategy, the federal government adopted Canada's first-ever national regulation on wastewater treatment, the Wastewater Systems Effluent Regulations (WSER). These regulations, established under the Fisheries Act in 2012, require wastewater systems to meet effluent quality standards equivalent to secondary level of treatment. While the WSER have strengthened the policy framework, the adoption of the standard has been slow in some jurisdictions. Further, the WSER have created some duplication and misalignments with existing provincial and territorial regulation, creating regulatory uncertainty. The review of how provincial regulations align with the new federal standard is time-consuming and progressing only slowly. This impacts the establishment of bilateral agreements between federal and sub-national jurisdictions to reduce administrative burden and set out procedures for co-operation between federal, provincial and territorial regulators. To date, agreements have been established with New Brunswick (2014), Yukon (2014) and Saskatchewan (2015); a draft agreement with Quebec was published in 2015, but has yet to be finalised; and discussions are underway with British Columbia.

The WSER do not apply to parts of the country (Northwest Territories, Nunavut and north of the 54th parallel in Quebec or Newfoundland and Labrador), as well as provinces and territories with equivalency agreements. Neither do they apply to smaller systems (with average daily volumes below 100 m^3). Absence of adequate regulation impairs the efficiency of policies and the improvement of wastewater management and water quality.

In addition to the strategy and new regulation, specific actions target selected lakes and rivers (e.g. Lake Winnipeg basin, Canadian Great Lakes, St. Lawrence River) in partnerships with provinces or with the United States. In 2005, Quebec, Ontario and the eight US Great Lakes states signed the Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement. It has been an important regional and international initiative led by provinces.

A long-term strategy is needed to secure funding for system upgrades

The condition of infrastructure for wastewater and rainwater collection and treatment has improved significantly over the last two decades. In 1995/96, about two-thirds of infrastructure was not operating at an acceptable level. In 2016, two-thirds of urban wastewater infrastructure was considered in very good or good condition (CIRC, 2016). Notwithstanding, urban wastewater management is in need of substantial and long-term financing to upgrade existing systems and adapt to upcoming challenges. At current reinvestment levels (about 0.7% to 1.4% of current assets), it would take about 100 years to renew existing infrastructure. This far exceeds the life expectancy of many pipes and appliances. The cost of regulatory compliance with the WSER is estimated at CAD 5.5 billion.

Prevailing sources of finance heavily rely on ad hoc budget transfers through both federal and provincial or territorial programmes (such as the Gas Tax Fund, the Green Municipal Fund and the Clean Water and Wastewater Fund). This generates risks of underfunding as public finance becomes scarce and contested, while providing few incentives to manage assets properly. Moreover, funding programmes disburse money to municipalities on a first-come first-served basis, without considering the relative benefit of individual projects across municipalities. Funds therefore do not always reach projects that generate the highest value for public money (e.g. the highest benefit in terms of improving water quality or urban wastewater treatment). There is no incentive for local governments to harness additional sources of finance (e.g. through tariffs).

Canada lacks a proven financial strategy to cover long-term investment needs. The use of pricing instruments for urban wastewater management – notably tariffs for wastewater services – are widespread. However, the level is too low to generate the revenues needed to cover the cost of urban wastewater management, or to provide the incentives to minimise future infrastructure needs. Canadian municipalities are far from recovering the full cost of the service and the full environmental cost through prices. Affordability is not the main obstacle to robust pricing strategies, as Canada ranks at the low end of water rates in OECD member countries.

Some municipalities embark in innovative urban design, for example, by better connecting waste- or rainwater collection and treatment with resource management. However, innovation depends on local initiatives and is not backed by federal policy. A vast majority of municipalities either ignore the challenges related to rainwater management or adaptation to climate change, or count on federal or provincial moneys to tackle it.

Recommendations on urban wastewater management

- Complete monitoring of the performance of wastewater management, and impacts on water quality, in places where information is lacking; improve consistency of monitoring frameworks across the country with a view to better identify hotspots and rank priorities.
- Invest in research to better understand the treatment efficacy of alternative technologies (including natural systems and wetlands), as well as the impact of effluent releases on wetlands' ecosystem health, under both normal and extreme climatic conditions. Build on that research to explore the possibility of expanding the coverage of the Wastewater Systems Effluent Regulations (WSER), across Canada, including northern territories.

Recommendations on urban wastewater management *(cont.)*

- Expedite discussions on bilateral agreements between the federal government and provinces for the WSER as one possible way to trigger policy responses and adjust regulatory frameworks at provincial and territorial level; systematically explore opportunities to streamline and speed up negotiations.
- Ensure that conditions attached to provincial and federal infrastructure funds for urban wastewater management bring about the best value for money by incentivising municipalities to: i) make the best use of existing assets; ii) develop investment pathways that maximise water security returns over time; iii) ensure synergies and complementarities with investments in other sectors, especially urban development, land use, rainwater management or energy; and iv) scale-up their own financing capacities, for instance by harnessing water users (with tariffs for wastewater and rainwater services) or property developers (with taxes that capture some of the rent accrued from improved water security).
- Increase tariffs for water and/or wastewater services to at least recover the operation and maintenance cost of wastewater collection and treatment.
- Systematically reflect the impacts of climate change on water availability and demand in all urban water management plans, infrastructure design and investment programmes across levels of government. Risks of heavy rains and urban floods deserve particular attention.
- Encourage innovative approaches to urban water management, by ensuring that financial support and regulation are not technology-prescriptive and can actively contribute to the diffusion of innovative and green infrastructure solutions, as appropriate; use federal funding to encourage cities to explore water-wise urban development (such as green roofs or permeable pavements) as potentially cost-effective, climate-resilient responses to heavier storms triggered by a changing climate.
- Further study risks associated with emerging pollutants, and explore cost-effective policy responses, including by raising public awareness on their effect on wastewater streams, with a view to avoid dumping. Other options build on new developments in monitoring techniques, such as effect-based monitoring.

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ANNEX A

Actions taken to implement selected recommendations from the 2004 OECD Environmental Performance Review of Canada

Recommendations	Actions taken
Chapter 1 – Environmental performance: Trends and recent developments	
Ensure proper implementation of Canada-wide Standards for ambient concentrations of $PM_{2.5}$ and ground-level ozone by 2010. Further reduce SO_2 and NO_x emissions (in line with 2010 targets) using the most cost-effective available policy measures (e.g. emissions trading in polluted areas, air emission charges, binding air emission standards and voluntary approaches); set a reduction target for VOC emissions and ratify the Gothenburg Protocol to the Convention on Long-range Transboundary Air Pollution.	In 2012, Canada introduced the Air Quality Management System (AQMS) as a national management system for air emissions and outdoor air quality. Under the AQMS, Canada strengthened air quality standards for $PM_{2.5}$ and ground-level ozone in 2013, announced a standard for SO_x in late 2016 and is establishing one for NO_x. Canada also established air pollutants regulations for some sectors or activities under the AQMS, and it strengthened trucks and vehicles regulations.
Firmly implement water management policies, including provincial water strategies (e.g. basin management, ecosystem approach, stakeholder participation) and enforcement of regulations (e.g. inspections, sanctions); accelerate the development of integrated water resource management and water efficiency plans.	The Canadian Council of Ministers of the Environment (CCME) has issued Canadian Environmental Quality Guidelines, including for drinking water, the protection of aquatic life, the protection of agricultural water uses and for sediment quality. Federal Wastewater Systems Effluent Regulations, in effect since 2015, establish specific effluent quality standards for municipal wastewater treatment plants. Many provinces are implementing policies and/or legislation to support integrated watershed management.
Complete the national park system; expand protected areas in the southern part of the country (where habitats are under much pressure); implement the new legal and institutional setting to improve management of national parks	The federal government and several provinces committed to the establishment of new protected areas.
Substantially increase the total area of marine and wetland ecosystems under protection.	Canada adopted several strategies and programmes such as Canada's Oceans Action Plan (2005), the Federal Marine Protected Areas Strategy (2005), the National Framework for Canada's Network of Marine Protected Areas (2011), the Health of the Oceans Initiative (2007-14), and the National Conservation Plan (2015-19). In 2016, the federal government committed to protecting 5% of Canada's marine and coastal areas by 2017 and 10% by 2020.
Implement the new legislation for the protection and recovery of species at risk, with particular emphasis on priority species.	Since 2004, hundreds of species at risk status assessments have been completed and recovery plans have been developed.
Take the necessary regulatory and financial steps to control the introduction and spread of invasive alien species.	The Invasive Alien Species Partnership Program ran between 2005 and 2012. It supported 170 projects totalling nearly CAD 5.6 million in funding to minimise the risk of invasive alien species.
Continue to advance scientific and economic analysis relating to environmental health; focus action on pollution affecting human health, including that of vulnerable segments of the population.	Canada conducts human health bio monitoring activities to study citizens' exposure to environmental chemicals such as lead, cadmium and mercury, including exposure of vulnerable populations such as pregnant women and Arctic populations.
Continue progress in improving water quality in the Great Lakes and other transboundary waters through co-operation with border country states (e.g. remediation of contaminated sediments, control of invasions by alien species); expand cross-border water ecosystem management (e.g. by promoting integrated, ecosystem approaches to transboundary water issues).	In 2012, Canada and the United States updated the 1987 Great Lakes Water Quality Agreement, which aims to identify shared priorities and co-ordinate actions to restore and protect the chemical, physical and biological integrity of the Great Lakes. In 2014, a new Canada–Ontario Agreement on Great Lakes Water Quality and Ecosystem Health was established.

Recommendations	Actions taken
Chapter 2 – Environmental governance and management	
Further implement federal and provincial environmental legislation, ensuring that federal and provincial compliance and enforcement programmes are well co-ordinated and adequately resourced.	Federal environmental authorities enter into various types of agreements (memoranda of understanding, administrative agreements, equivalency agreements and collaboration agreements) with their provincial and territorial counterparts to facilitate the implementation of relevant legislation. Provinces also engage in interagency collaboration in compliance monitoring. For example, the Ministry of Environment of British Columbia co-ordinates its inspections with the Ministry of Energy and Mines, Ministry of Forests, Lands and Natural Resource Operations, Department of Fisheries and Oceans, provincial work safety and health authorities, as well as Environment and Climate Change Canada (ECCC) and local governments.
Continue to develop cost-effective voluntary approaches within industry, ensuring that these approaches are consistent with ECCC's 2001 policy framework.	ECCC uses performance agreements that commit participating sectors or companies to specific measures or performance levels. Every agreement requires verification of results through audits, inspections, interviews or other means. Since the adoption of the federal Policy Framework for Environmental Performance Agreements in 2001, ECCC has signed 15 such agreements with different industries, including chemicals, transportation, metal processing, consumer products, forestry and printing.
Continue to develop and expand the use of strategic environmental assessment.	In accordance with the 2010 Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals, strategic environmental assessment (SEA) must be conducted when the implementation of the proposal may result in important positive or negative environmental effects. However, the SEA Cabinet Directive was applied to only 23% of the 243 policy, plan, and programme proposals submitted for approval to Cabinet in 2013-15.
Continue and strengthen efforts to implement co-ordinated inter-jurisdictional decision making that integrates environmental, social and economic policies.	The main intergovernmental forum addressing environmental issues is the CCME, comprised of environment ministers from the federal, provincial and territorial governments. It addresses issues relating to air, water, waste, contaminated sites and climate change. Based on the March 2016 Vancouver Declaration on clean growth and climate change, the federal government worked with provinces and territories to establish a pan-Canadian framework for clean growth and climate change in December 2016.
Make further progress on unsettled land claims in order to remove uncertainties about land and resource rights and foster economic development in Indigenous communities; continue devolution of land and resource management to the northern territorial governments and Indigenous self-governing communities.	Indigenous and Northern Affairs Canada negotiates and implements land claim and self-government treaties on behalf of the Government of Canada and helps build strong partnerships among Indigenous peoples, governments and the private sector. In July 2014, Canada released an interim Comprehensive Land Claims Policy to identify further reforms to advance land claims negotiations and facilitate reconciliation with Indigenous communities.
Continue efforts to develop and strengthen high-quality and integrated environmental information and data and implement the Canadian Information System for the Environment; report periodically on the state of the environment; further develop new natural and human capital indicators.	The Canadian Environmental Sustainability Indicators programme provides data and information to track Canada's performance on key environmental sustainability issues, including climate change and air quality, water quality and availability, and protecting nature. Many new indicators have been developed and published since 2009. In addition, Statistics Canada's environmental statistics programme produces data series on various components of natural capital (water, ecosystems, sub-soil minerals), natural resource use, pollution and environmental protection expenditures.
Continue to strengthen surveillance and enforcement capabilities, at both federal and provincial levels, with additional staff and expanded investment in technology, to address marine problems (e.g. fishing violations, marine oil spills) and illegal trade (e.g. in endangered species, ozone-depleting substances and hazardous waste).	ECCC conducts its inspections and investigations separately under each statute it is responsible for. Factors that influence the identification of the priority regulations for compliance monitoring include the nature of regulatory provisions, operational complexity and capacity, and domestic and international commitments. In addition, when new regulations are brought into effect, they are identified as priorities within ECCC's inspection programme. Risk-based targeting of environmental inspections has been introduced at the federal and provincial levels: the inspection schedule is determined by the risk that the regulated substance or activity presents to the environment or human health, and by the compliance record of the regulated entity.

Recommendations	Actions taken
Chapter 3 – Towards green growth	
Consider ways to improve the cost-effectiveness of environmental policies by extending the use of economic instruments such as charges for water supply and air and water pollution; further implement emissions trading schemes (e.g. for GHGs, SO_x and NO_x).	The four most populous provinces have introduced carbon pricing. In December 2016, the federal government and 11 of 13 provinces and territories agreed to the Pan-Canadian Framework on Clean Growth and Climate Change (PCF), which includes national carbon pricing. It sets a national benchmark of CAD 10 per tonne of CO_2 in 2018, rising to CAD 50 per tonne by 2022. Provinces and territories are able to implement their own cap-and-trade or carbon tax systems, with a federal policy applying in jurisdictions that have not implemented their systems by 2018. There are few trading systems in place for air pollution (in Ontario and Alberta) and targeted water pollution charges (in British Columbia and Quebec).
Prepare an integrated federal sustainable development strategy (including greening of the federal budget); develop and/or implement provincial sustainable development strategies.	The 2008 Federal Sustainable Development Act requires a whole-of-government strategy every three years. The 2016-19 strategy includes 13 goals linked to the global Sustainable Development Goals, with specific targets and short-term milestones to achieve them. Several provincial governments have developed their own sustainable development strategies.
Continue to phase out environmentally harmful subsidies at both federal and provincial levels, including subsidies in the form of tax incentives for the resource-based economic sectors.	Federal measures to phase out fossil fuel subsidies include the phasing out of tax benefits for oil sands production. Ontario removed its sales-tax exemptions for energy products.
Review existing environmentally related taxes (e.g. taxes on transport and on energy products) with a view to restructuring them in a more environmentally effective way, within a neutral fiscal context, at both federal and provincial levels.	While no comprehensive review has been undertaken, progress has been made through the introduction of carbon pricing.
Employ, strategically and rigorously, the range of tools available to the government to promote improved environmental management in developing countries (e.g. expansion of ODA, CIDA's new policy directions, Canada's membership on the boards of international development banks, the Canadian Export Development Corporation's environmental review requirements).	In 2015, Canada launched a review of its approach to international assistance, identifying clean economic growth, climate change and water as key areas of focus for the new policy framework.
Review Canada's record in ratifying and implementing international agreements.	While Canada retreated from some environmental agreements since 2004 (the Kyoto Protocol and the UN Convention to Combat Desertification), the government is now actively engaged in the Paris Agreement on Climate Change and has re-joined the desertification convention. The government has also committed to achieve the Aichi targets for protected areas by 2020. Canada plays an important role in other international partnerships, including the Climate and Clean Air Coalition, the Arctic Council Task force on Black Carbon and Methane, the Global Methane Initiative and the Carbon Pricing Leadership Coalition.
Chapter 4 – Climate change mitigation	
Reduce the energy intensity of the economy and increase the share of low-emission energy sources, particularly through further internalising environmental externalities in energy prices for industry and households.	Energy intensity has been targeted mainly through indirect measures such as energy labelling, fuel economy standards, not through pricing externalities. Under the Energy Efficiency Act, the government of Canada is required to submit an annual report to Parliament on its energy efficiency and alternative transportation fuels programmes and their performance. In 2012, the federal government published regulations to reduce GHG emissions from coal-fired electricity. Renewable energy has been supported by large subsidies rather than taxes on non-renewables. Some provinces introduced similar regulation to phase out coal and introduced carbon pricing mechanisms. The Pan-Canadian Framework on Clean Growth and Climate Change (PCF) will promote further internalisation of environmental externalities in energy prices, notably through the introduction of Canada-wide carbon pricing by 2018.
Expand use of economic instruments in the transport sector (e.g. tax breaks for individuals using public transport, incentives to promote shift from road to rail freight transport, incentives to purchase fuel-efficient vehicles, gasoline taxation).	The federal government introduced an excise tax on fuel-inefficient passenger vehicles called the "Green Levy" in 2007, tied to vehicle average weighted fuel consumption. A rebate for efficient vehicles was introduced at the same time as the levy, but cancelled in 2010. Taxation on motor fuel remains among the lowest in the OECD. Sectoral plans are often based on voluntary agreements rather than economic instruments. There are subsidies for electric vehicles in some provinces, but local transport plans such as the Ontario "Big Move" is based more on provision of public transport than positive incentives.
Further elaborate and aggressively implement the (2002) Climate Change Plan for Canada, using a broad array of policy instruments (including emissions trading and other flexibility mechanisms) to ensure that GHG targets are met effectively and efficiently; continue to analyse the costs and benefits of various GHG control measures, including the cost of no action as well as ancillary benefits of taking action; expand co-operation internationally regarding common approaches to GHG reduction.	The 2002 Climate Change Plan for Canada was not aggressively implemented. Provinces and territories took a wide range of measures with some similarities, but little explicit co-ordination. Key measures included coal phase-outs in several provinces. Canada withdrew from the Kyoto Protocol in 2011, but is a signatory to the Paris Agreement. By 2017, the four most populous provinces had some form of carbon pricing in place. The PCF was adopted in 2016 as a framework to help Canada achieve its commitment of reducing GHG emissions by 30% by 2030.

Recommendations	Actions taken
Chapter 5 – Urban wastewater management	
Speed up the access to water supply and sanitation infrastructure for all Canadians.	Canadian provinces and territories have the primary jurisdiction over most areas of water management and protection. The federal government delivers infrastructure funding through various mechanisms. Starting in 2016, it provides CAD 5 billion over five years for investments in water, wastewater and green infrastructure projects. Additional funding is made available for supply and sanitation infrastructure for First Nations communities.
Improve efficiency in the delivery of water and wastewater services, through improved governance (e.g. consolidation of operators, quality assurance, accountability mechanisms), improved supply management (e.g. source-to-tap approaches for municipal drinking water systems, protection of rural water supply wells against contamination, maintenance and renewal of municipal water-related infrastructure) and demand management (e.g. water metering, technical measures, use of economic instruments, appropriate pricing levels and structures).	Several initiatives aimed to improve collaboration between the federal and provincial/territorial governments. For example, Health Canada collaborates with the provinces and territories to develop or update the health-based guidelines that are used as the basis for drinking water requirements. In 2009, the CCME endorsed the Canada-wide Strategy for the Management of Municipal Wastewater Effluent, which facilitates the development of a harmonised approach for the management of wastewater effluent. The 2013 Safe Drinking Water for First Nations Act enables the federal government to develop, in partnership with First Nations, enforceable federal regulations to ensure access to safe, clean and reliable drinking water, the effective treatment of wastewater and the protection of sources of drinking water on First Nations lands.
Review systematically subsidies for water supply and treatment infrastructure and water pricing practices, aiming at cost-effectiveness and long-term financing in the maintenance and upgrading of facilities; review subsidies for flood and drought control projects in terms of their long-term impact on risk; progressively move to full-cost pricing while taking account of social factors and the needs of First Nations and Inuit communities.	The 2011 Municipal Water Pricing Report summarised information on water and wastewater pricing and conservation measures collected through the 2009 Municipal Water and Wastewater Survey. It showed that metering and volumetric charging for water services have increased, contributing to a decrease in drinking water consumption. Most provinces levy licence fees to major water users for access to the resource; fees are set related to the cost of administering the licensing programme. Use of water conservation/ demand management measures varies widely across Canada.
Continue to promote reduction of water use and releases of water effluents from large as well as small and medium-sized enterprises (SMEs).	No targeted measures were implemented to reduce water use from large as well as SMEs. However, the 2013-16 Federal Sustainable Development Strategy included a target to reduce risks associated with effluent from wastewater (sewage) and industrial sectors by 2020. Statistics Canada conducts surveys to collect information related to the use of water in industry.
Improve the information and knowledge base for water management, including i) harmonised and up-to-date monitoring of ambient water quality; ii) better data on expenditure, prices and financing; and iii) further analysis of micro-economic conditions facing key water users.	Canada uses a number of water surveys to track water-related activities in Canada including for industrial water use, agricultural water use, a survey of drinking water plants and a household survey that includes a section on water use. A Municipal Water and Wastewater Survey is conducted every two years.

PART I

Progress towards sustainable development

PART I

Chapter 1

Environmental performance: Trends and recent developments

Canada's economy has grown strongly over the past decade, supported by high commodity prices that boosted income from energy and agricultural exports. However, economic growth has increased energy and resource use, escalating environmental pressures. This chapter examines the country's progress in decoupling economic activity from these environmental pressures, focusing on the period since 2000. It presents the key socio-economic developments and reviews Canada's progress in moving towards an energy-efficient and low-carbon economy; resource efficiency in material consumption and waste management; and sustainable management of the natural asset base.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Introduction

With a territory of nearly 10 million square kilometres (km^2), Canada is the second largest country in the world. It is an open economy that sources a significant share of its income and exports from natural-resource based activities such as mining, fossil fuel extraction, agriculture, forestry, fisheries and nature-related tourism. The commodity super-cycle of the mid-2000s helped the country quickly recover from the global financial crisis, even though the fall in oil prices has slowed growth and increased unemployment. Canadians generally enjoy a high quality of life. However, parts of the population, including remote Indigenous communities, lack equal access to essential services, and they are more vulnerable to environmental degradation and the effects of climate change. While Canada has decoupled several environmental pressures from economic growth, it still faces challenges associated with high energy and resource consumption, high greenhouse gas (GHG) emissions, and pressures on biodiversity and water resources.

This chapter provides an overview of Canada's main environmental achievements, and its remaining challenges on the path towards green growth. Drawing on indicators from national and international sources, it reviews progress on national policy goals, and on international commitments and targets, focusing on the period since 2000. To the extent possible, it compares the state of the environment and key environmental trends with those of other OECD member countries. The chapter sketches out major policy developments in environmental sectors, including air, climate, waste, water and biodiversity.

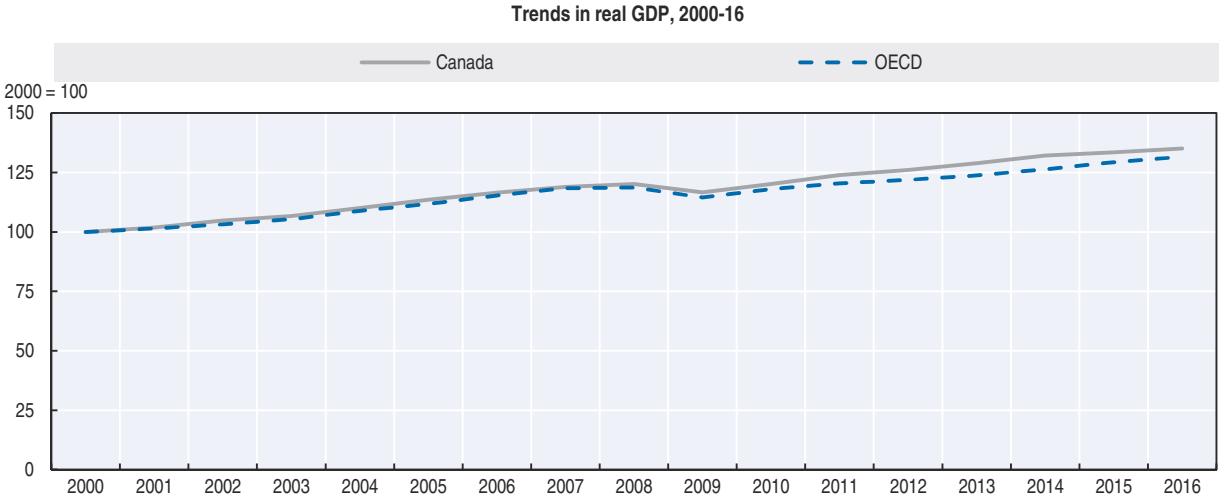
2. Key economic and social developments

2.1. Economic performance and structure of the economy

Canada is the eleventh largest economy in the OECD. Real gross domestic product (GDP) increased by about 35% over 2000-16, compared with the OECD average of 32% (Figure 1.1). Between the turn of the century and the beginning of the global economic crises, the economy grew in line with the OECD average. It recovered from the crisis more strongly than most other OECD member countries (at 1.5% annually in 2008-15). The impressive rise in commodity prices (e.g. for oil, coal and iron ore) aided the quick recovery, boosting GDP in energy- and mining-dependent provinces. The recovery was also supported by a prudent banking system, supportive fiscal and monetary policies, and a comparatively strong recovery in the United States (Canada's main trading partner, which took 76% of merchandise exports in 2015) (OECD, 2016a). The sharp drop in oil prices since mid-2014 has hit the economy. Growth picked up again in late 2015, however, and is expected increase to 2.2% in 2017/18 (OECD, 2016b).

Canada's open and diversified economy is more reliant on natural resources than the economies of most other OECD member countries. Contribution of the services, industry and agricultural sectors to GDP is similar to the OECD average (see Basic Statistics). However, roughly one-quarter of industrial activity is linked to oil, gas, mineral and metal extraction. In total, primary industries account for roughly 10% of GDP and 40% of exports (Figure 1.2).

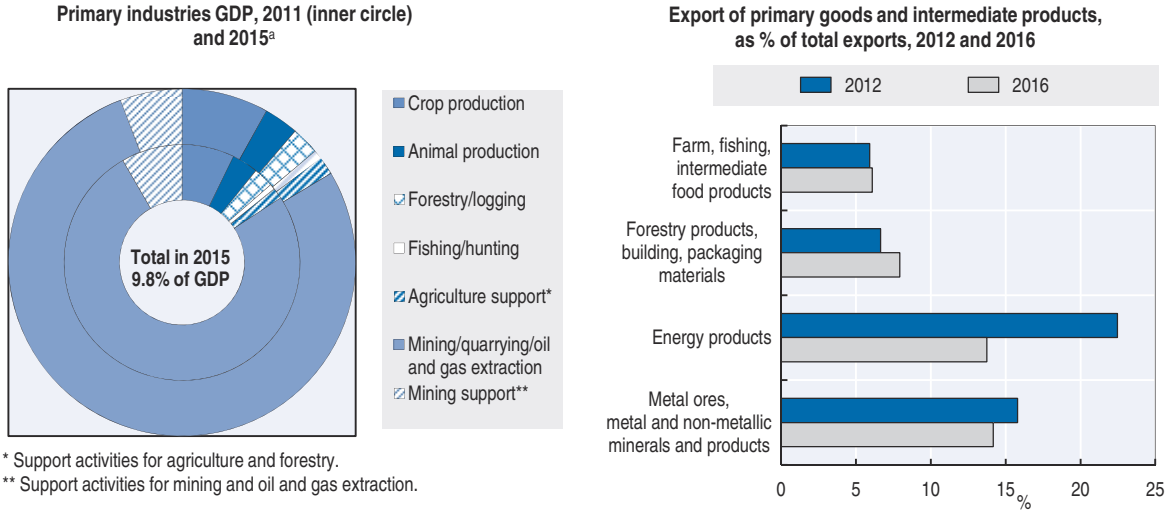
Figure 1.1. **Canada recovered from the financial crisis more strongly than most other OECD countries**



Source: OECD (2017), *OECD National Accounts Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933565184

Figure 1.2. **Natural resources are a backbone of the economy**



* Support activities for agriculture and forestry.
** Support activities for mining and oil and gas extraction.

a) According to the North American Industry Classification (NAICS) 2007 and based on data expressed at 2007 chained prices.
Source: Statistics Canada (2017), "Table 379-0031" and "Table 228-0059", *CANSIM* (database).

StatLink http://dx.doi.org/10.1787/888933565203

Canada is one of the world's top five producers of crude oil, natural gas, primary aluminum and copper. It is also a major exporter of pulp, paper and a number of agricultural commodities such as wheat, canola, soybeans and vegetables. According to Statistics Canada's Natural Resources Satellite Account[1], natural resources directly or indirectly accounted for an estimated 17% of GDP and employed 1.8 million people (nearly 10% of the workforce) in 2015; natural resource exports were valued at CAD 231 billion (NRCan, 2016).

The rise in international oil prices has shifted the country's industrial mix to become increasingly weighted towards oil and gas. Between 2000 and 2015, oil production increased by 76%, owing mainly to a threefold increase in unconventional production from oil sands in

the province of Alberta (IEA, 2017a). GDP generated from Canada's energy sector increased faster than the economy as a whole between the 2009 financial crises and the peak in oil prices in 2014. The sharp fall in oil prices since mid-2014 has, however, depressed business investment in the mining, and oil and gas sector, and heightened unemployment in oil-producing provinces. The economy is adjusting to lower prices, with activity shifting notably towards non-resource export-related sectors (e.g. finance and insurance, real estate, retail trade, transportation and warehousing). Exchange rate depreciation, flexible labour markets and accommodating monetary and fiscal policy are supporting economic adjustment. However, Canada's growth outlook is constrained by low productivity levels, resulting from insufficient competition in network sectors, barriers to internal trade and low small business dynamism. Other factors affecting growth include vulnerabilities in the financial system deriving from low oil prices, as well as historically high house prices, housing investment and household debt (IMF, 2016; OECD, 2016a).

Efforts to consolidate the public budget both at the federal and provincial level narrowed the general government overall deficit from a post-recession peak of 4.7% of GDP in 2010 to 0.5% in 2014 (OECD, 2016a). However, the deficit rose to 1.7% of GDP in 2015, reflecting deteriorating public finances in oil-producing provinces. The federal government has adopted a moderately expansionary fiscal policy stance to boost growth. This included increased public investment in infrastructure and clean technology, as well as funding to substantially improve the sub-standard socio-economic conditions facing Indigenous peoples (Chapter 3). General public debt has increased to 98% of GDP, but remains below the OECD average (see Basic Statistics).

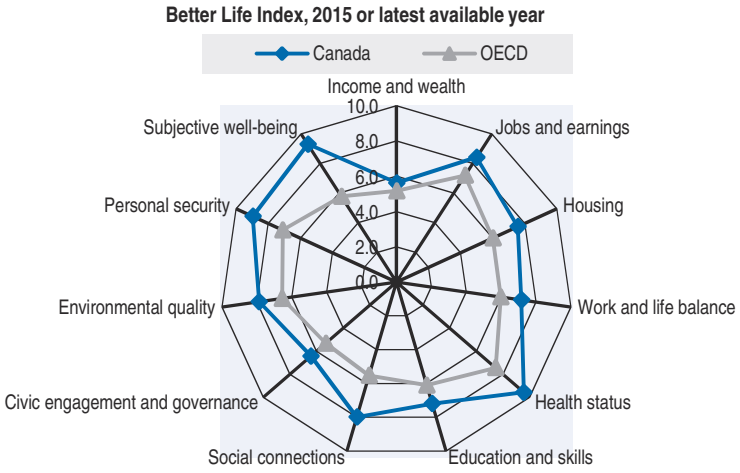
2.2. Population, well-being and environmental quality of life

As the world's second largest country by area, Canada's population density is only a tenth of the OECD average (see Basic Statistics). The country is highly urbanised, with most Canadians living in widely separated urban centres along the US border (about 80%), along the east coast in the Atlantic provinces and along the west coast in British Columbia. Only 0.3% of the population lives in Canada's large northern territories, where climatic conditions are difficult, living costs are high and access to public services is lower. Regional disparities are therefore important.

Canada's population has increased by 18% since 2000 (to reach 36 million in 2016), mostly as a result of international labour migration. Its population has diverse backgrounds: nearly 20% have immigrated to the country (one of the highest shares in the world). Indigenous peoples (including First Nations, Métis and Inuit) make up 4.3% of the population. Many indigenous communities face critical social problems: they are often poor and are more likely than other Canadians to live in sub-standard housing, to drop out of school, be unemployed, to suffer from health problems (OECD, 2016a). The federal government has made improving outcomes for Indigenous peoples a priority.

Canada performs better than the OECD average on all dimensions of well-being of the OECD's Better Life Index (Figure 1.3). Per capita GDP increased by 13% over 2000-15 (in real terms) and is above the OECD average. The poverty rate has fallen slightly and is now close to the OECD average. The level of income inequality in Canada has been relatively stable since 2000, with the top 20% of the population earning about five times as much as the bottom 20% – slightly below the OECD average (OECD, 2016c). The average Canadian enjoys high quality education, good health care and good housing conditions. Employment has grown solidly since the global recession, although the unemployment rate has stalled its

Figure 1.3. **Canadians enjoy a high quality of life**



Note: The OECD Better Life Initiative (BLI) framework is based on 11 topics considered a good measure of the concept of well-being. Each dimension is based on one to three indicators with equal weights and then normalised to range between 10 (best performance) and 0 (worst performance). The OECD aggregate is weighted by population. Income data refer to 2012.
The environment dimension of the well-being indicator focuses on citizens' satisfaction with local water quality and on annual popoulation exposure to fine particulates ($PM_{2.5}$).
Source: OECD (2015), *OECD Better Life Index, www.oecdbetterlifeindex.org.*

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downward trend at around 7% in 2015, following layoffs in energy-producing provinces. Life expectancy at birth is 82 years, one year higher than the OECD average. Satisfaction about environmental quality seems generally high: 9 out of 10 Canadians are satisfied with air and water quality, though only 60% are satisfied with public transport (Gallup, 2016).

3. Transition to an energy-efficient and low-carbon economy

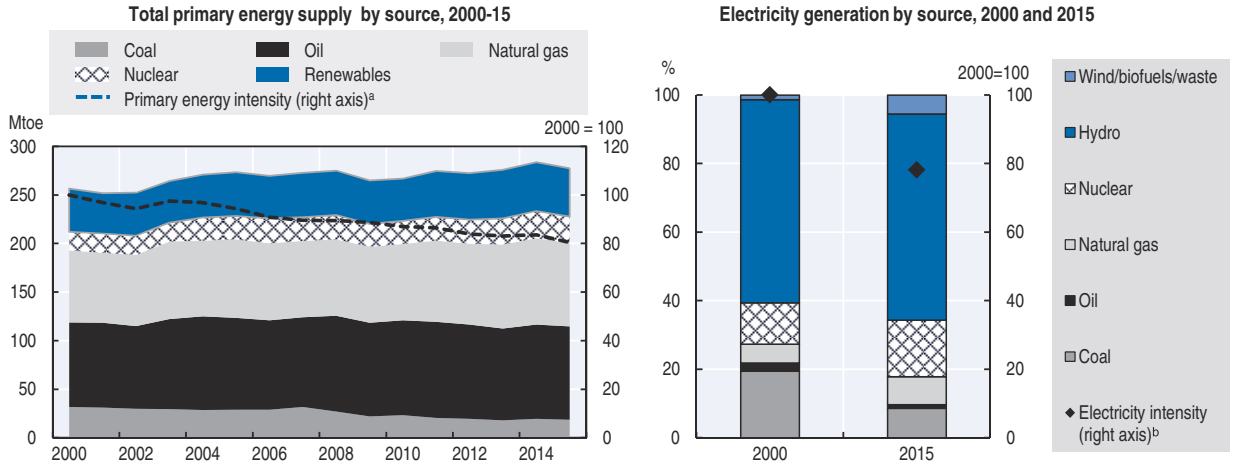
3.1. Energy supply and demand

An energy mix dominated by fossil fuels

As in most OECD member countries, fossil fuels dominate the energy mix. Oil, natural gas and coal together accounted for 74% of total primary energy supply (TPES)[2] in 2015, compared to 80% in the OECD as a whole. The share of fossil fuels in TPES has remained relatively stable since 2000, with a slight shift from coal to oil and natural gas. The share of renewables has remained under 20%, while that of nuclear energy increased from 7% to 10% (Figure 1.4).

Canada's electricity mix is among the least carbon-intensive in the OECD. More than 81% of its electricity comes from non-emitting sources, mostly hydro (60%) and nuclear (17%). However, the electricity mix varies significantly across provinces and territories: British Columbia, Quebec, Manitoba, Newfoundland and Labrador, and Yukon primarily rely on hydropower to meet their electricity demand, while Alberta, Nova Scotia and Saskatchewan generate about half their electricity from coal, albeit natural gas has increasingly replaced coal in the two western provinces (see Chapter 4). Nationally, this shift led to decreased use of fossil fuels in electricity generation over 2000-15 from 27% to 18% (Figure 1.4), the sixth lowest share in the OECD. Meanwhile, the share of renewable sources has increased from 60% to 66%, owing mainly to an increase in wind and hydro power. Indeed, wind power has tripled in the past five years and now accounts for 5% of electricity generation. Solar power also increased, but its share remains small (at 0.4% of electricity generation) (IEA, 2017a).

Figure 1.4. **The energy mix is dominated by fossil fuels, albeit power generation is low-carbon**



a) Total primary energy supply per unit of GDP at 2010 prices and PPPs.
b) Electricity generation per unit of GDP at 2010 prices and PPPs.
Source: IEA (2016), *IEA World Energy Statistics and Balances* (database); OECD (2016), *OECD National Accounts Statistics* (database).

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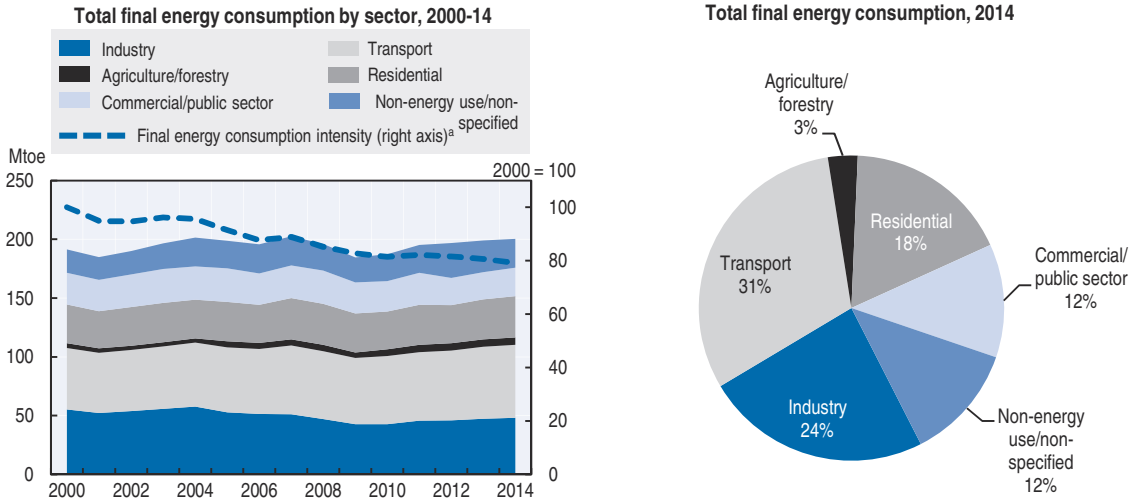
Energy intensity remains high

Despite improvement, Canada remains one of the most energy-intense economies in the OECD, whether measured per unit of GDP or per capita. This reflects Canada's vast energy reserves, energy-intensive extraction and processing for exports. It also reflects high living standards and the country's geography and climate, which demand transport over large distances and more energy for heating (IEA, 2016a). Energy intensity (TPES per unit of GDP) has declined by 20% since 2000 (Figure 1.4), compared to 22% in the OECD as a whole. Canada has no quantified national target for improving energy intensity, but several provinces are implementing ambitious energy savings programmes (Chapter 4).

Total final energy consumption (TFC)[3] increased by 5% over 2000-14, far less than economic activity (32%). Transport is the largest consuming sector, followed by industry and the residential sector (Figure 1.5). Energy demand from the transport sector (mostly road transport) has increased by 19% since 2000, more than offsetting energy savings in the industrial, commercial and public sectors. Energy demand from industry decreased thanks to efficiency improvements in several energy-intensive industries (including iron, steel, metals and pulp and paper), as well as the economic contraction during 2007-09. However, there remains significant energy-saving potential across the Canadian economy, notably in the mining and quarrying industry (including oil and gas extraction). The mining and quarrying industry has experienced high growth in energy consumption over the past decade, with practically no improvement in energy efficiency (IEA, 2016a). Energy industry own use (e.g. energy consumed in power plants or for oil and gas extraction) has more than doubled since 2000; it accounted for 18% of TPES in 2014, compared to 6% in the OECD as a whole (IEA, 2017a).

Electricity demand, driven by the residential sector, rose by 6% over 2000-14. Final household electricity prices are the third lowest in the OECD (excluding taxes), after Norway and Sweden, providing few incentives for savings. Low prices reflect Canada's vast resource endowments for power generation, yet also weak electricity taxation and regulated prices that are kept at low levels to protect households and businesses (Chapter 3). Electricity production has increased slightly more than electricity consumption (+4% over 2000-15), reflecting greater exports to, and fewer imports from, the United States (IEA, 2017a).

Figure 1.5. **Energy demand from transport has more than offset energy savings in the industrial, commercial and public sector**



a) Total final energy consumption per unit of GDP at 2010 prices and PPPs.
Source: IEA (2016), *IEA World Energy Statistics and Balances* (database); OECD (2016), *OECD National Accounts Statistics* (database).

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3.2. Transport

Transportation plays a large role in Canada, given the need to move people and goods over vast geographical distances across the North American market. Not surprisingly, transport is one of the most energy-consuming and GHG-emitting sectors. In international comparison, energy use and CO_2 emissions from transport, on a per capita basis, are the third highest in the OECD (after Luxembourg and the United States) (IEA, 2017b). Transport-related energy use and CO_2 emissions have continued to grow since 2000, although the latter at a slower pace since the mid-2000s. This is due, in part, to federal GHG emission regulations for on-road light- and heavy-duty vehicles that came into effect in 2011 and 2014, respectively, as well as provincial and federal fuel standards, and investments in public transit infrastructure (IEA, 2016a).

Road transport makes up 80% of energy consumption in transport (IEA, 2017b). Between 2000 and 2015, the total number of on-road vehicles in Canada increased by 34% (Statistics Canada, 2017a). Heavy-duty vehicles have the most significant increase (+72%). There has also been a shift to larger sport utility vehicles (SUVs) and trucks, and growing use of freight transportation (see also Chapters 3 and 4). Canada is one of only a few countries that applies GHG emission standards for heavy-duty trucks.

Air transport plays an important part in the movement of people, time-sensitive cargo and goods to northern and remote regions. The weight of aviation in domestic transport is the fourth highest in the OECD, after Australia, the United States and Norway. In many cases, few alternatives exist, except over short distances. Rail transport is dominated by freight. Inter-modal competition exists over short distances (including competition from trucking), but over long distances there are few cost-effective alternatives. The absence of road pricing combined with the commercial structure of freight shipping (such that shippers are implicitly charged the full cost of rail infrastructure) may bias the freight transport system against rail in favour of trucking over these shorter distances (OECD, 2016a; also see Chapter 4).

3.3. Climate change mitigation and adaptation

Emissions profile

In 2014, Canada was the fourth largest emitter of GHG emissions in the OECD in absolute terms (excluding land use, land-use change and forestry, or LULUCF). Emissions have been relatively stable in the first half of the 2000s, dropped alongside economic activity during the 2008-09 global financial crisis, and increased over the following years (Figure 1.6). In 2014, emissions stood 1.5% below the 2000 level, which compares to a decrease of 4.7% in the OECD as a whole. Emissions have risen in Alberta, Saskatchewan, Newfoundland and Nunavut, while they have decreased in all other provinces and territories. Alberta, which accounts for nearly 40% of national emissions, saw its emissions increase by 18% over 2000-15. This was largely as a result of its dynamic oil and gas sector, particularly the development of oil sands.

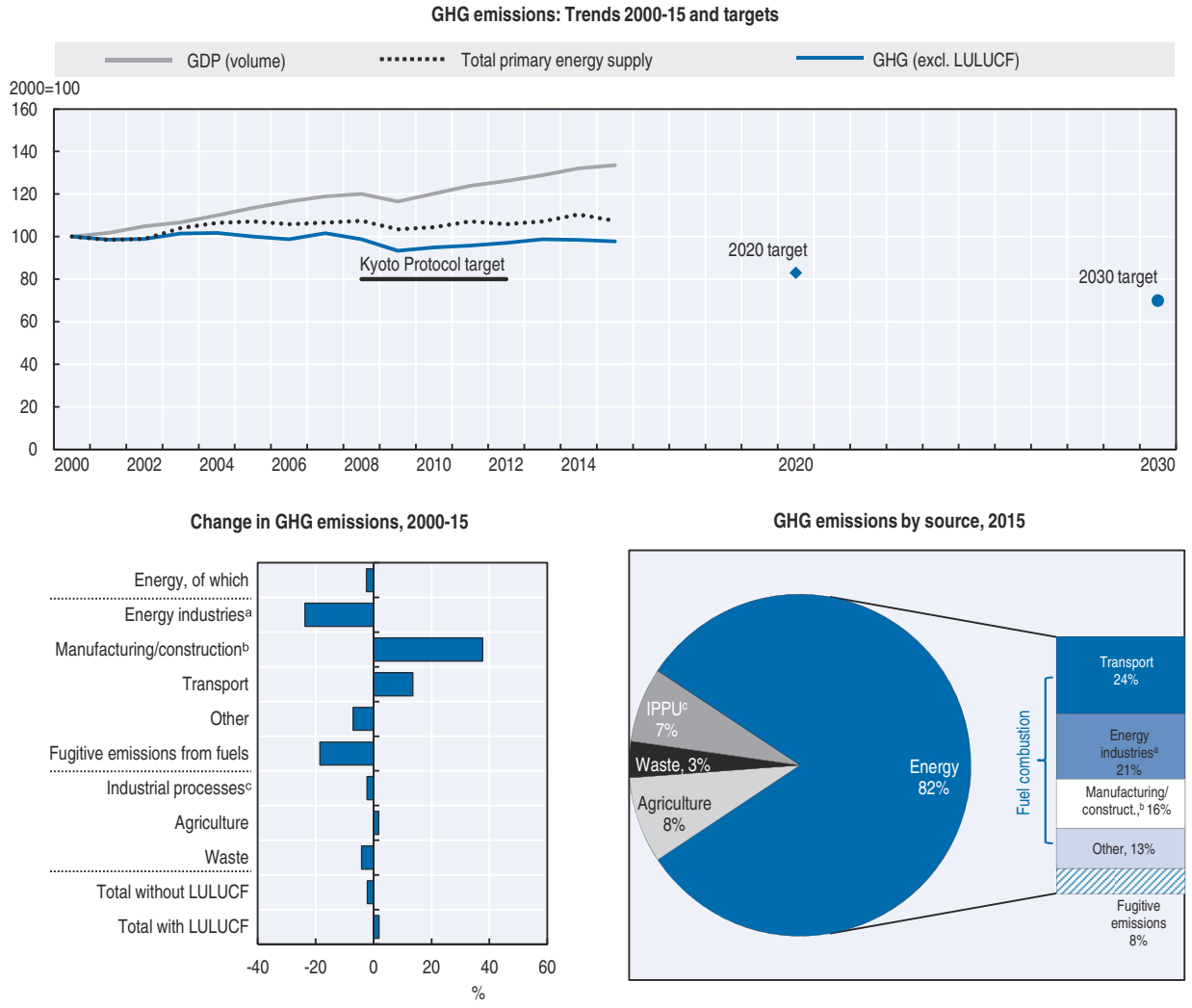
Nationally, Canada achieved a decoupling of both economic growth and energy supply from domestic GHG emissions (Figure 1.6). GHG emission intensities therefore improved over 2000-15, both in terms of GDP (-27%) and per capita (-17%). Despite this improvement, Canadian emissions intensities are still among the highest in the OECD. This reflects the country's geography, industrial structure (with energy extraction industries emitting large quantities of GHGs) and its carbon intensive-energy mix (Section 3.1). As in most OECD member countries, CO_2 is the main contributor to GHG emissions, amounting for nearly 80% of total emissions (Chapter 4). Consumption-based CO_2 emissions (i.e. excluding emissions embodied in Canada's exports) have increased less rapidly than production-based emissions. On a per capita basis, Canadian consumption-based CO_2 emissions are the third highest in the OECD (after the United States and Australia) and 50% above the OECD average.

The energy sector is responsible for the lion's share (82%) of national GHG emissions (Figure 1.6). Within the energy sector, transport accounted for 30% of total emissions, energy industries for 26%, energy use in manufacturing industries and construction for 19%, and fugitive emissions for 10%.[4] Unconventional oil production from oil sands is roughly four times as intensive per barrel as conventional crude produced in North America. Emissions from energy industries decreased considerably between 2000 and 2015. This reflects a shift from the use of coal to natural gas for the development of unconventional fossil fuels, including oil sands. However, much of this decline was offset by emissions from transport, and the manufacturing and construction sector (which comprises oils sands mining and extraction activities), which kept rising (Figure 1.6).

Climate targets appear hard to achieve

Under the Kyoto Protocol, Canada pledged to reduce GHG emissions to 6% below 1990 levels during the first commitment period 2008-12. It introduced a number of measures during the first half of the 2000s, but the government acknowledged in 2006 that it was not on track to meet its target (emissions then were 20% above 1990 levels). It formally withdrew from the protocol in 2011. Prior to its withdrawal, Canada signed the 2009 Copenhagen Protocol, which set a new target of reducing emissions by 17% from 2005 levels by 2020 (aligned with the US target). In its Nationally Determined Contribution (NDC) following the Paris Agreement, which Canada ratified on 5 October 2016, Canada set the target of reducing emissions by 30% from 2005 levels by 2030. In practice, the 2020 and 2030 targets postpone the mitigation target set under the Kyoto Protocol (Figure 1.6).

Figure 1.6. **GHG emissions are decoupled from economic growth, but show no sign of falling yet**



a) Comprises emissions from fuel combusted by fuel extraction or energy production industry.
b) Comprises emissions from oil sands mining and extraction and related on-site off-road emissions.
c) Industrial processes and product use.
Source: ECCC (2017), *National Inventory Report 1990-2015*; IEA (2016), *IEA World Energy Statistics and Balances* (database); OECD (2016), *OECD National Accounts Statistics* (database).

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In 2015, emissions (excluding LULUCF) were 2.2% below 2005 levels. Achieving the 2030 target means an average annual reduction of 1.7%, considerably faster than what has been achieved since 2005 (OECD, 2016c). The federal government has stated it may rely on land use and international offsets to reach its 30% target. Taking this into account, Canada would need to reduce energy-related GHG emissions by 18% below 2005 (IEA, 2016b).

Canada has accelerated efforts to reduce emissions following the Paris Agreement. Before 2016, federal policy action on climate change operated primarily through a sector-based regulatory approach, including stringent regulations for coal-fired electricity generation, as well as progressively tightening standards for passenger vehicles, light trucks and heavy-duty vehicles (aligned with tighter standards introduced in the United States). In December 2016, Canadian First Ministers announced the Pan-Canadian Framework on Clean

Growth and Climate Change (PCF), a comprehensive action framework based on carbon pricing, complementary regulations to reduce emissions, promotion of clean technology innovation and jobs, and support to adapt to climate change. The PCF sets a federal minimum carbon price of CAD 10 per tonne by 2018 (rising to CAD 50 per tonne by 2022). Provinces will need to meet that minimum, or exceed this price, by either a price-based system (e.g. a carbon tax) or a comparable emissions reduction through a cap-and-trade system (see Chapter 3). Without full implementation of the PCF, Canada will not meet its 2030 target (Chapter 4).

Provinces had already moved increasingly towards employing market-based instruments to address GHG emissions; Canada's four most populous provinces already deployed or had introduced some kind of carbon price. British Columbia introduced a carbon tax in 2008. Quebec implemented a modest carbon levy on fuel from 2007 to 2014 and introduced a cap-and-trade system in 2013, which is now linked with California's system under the Western Climate Initiative (WCI). Ontario launched a similar cap-and-trade system in January 2017 and intends to join Quebec and California under the WCI in 2018. Alberta uses a hybrid system with an economy-wide carbon price combined with a trading scheme for large emitters. In spite of these measures, the current price of carbon in Canada remains relatively low (see Chapter 3).

Climate change outlook and adaptation policy

Canada is more vulnerable to the impacts of climate change than many OECD member countries. The average temperature increased by 1.3 degrees between 1950 and 2010, a rate that is about twice the global average. In northern Canada (north of 60°N), the rate of warming has been roughly three times the global mean (ECCC, 2016b). Average precipitation has increased, while Arctic sea ice has declined and glaciers in western Canada and the Arctic have shrunken. Climate change is expected to continue to alter rainfall, snowfall, permafrost and ice conditions in Canada. This will likely increase the frequency and intensity of extreme weather events such as wind, ice and snow storms, heavy rains and flooding, but also heat waves and coastal erosion. Climate change adaptation measures are thus essential to face future challenges. At the same time, new economic opportunities may arise, in particular related to resources that become accessible in currently ice-covered regions in northern Canada.

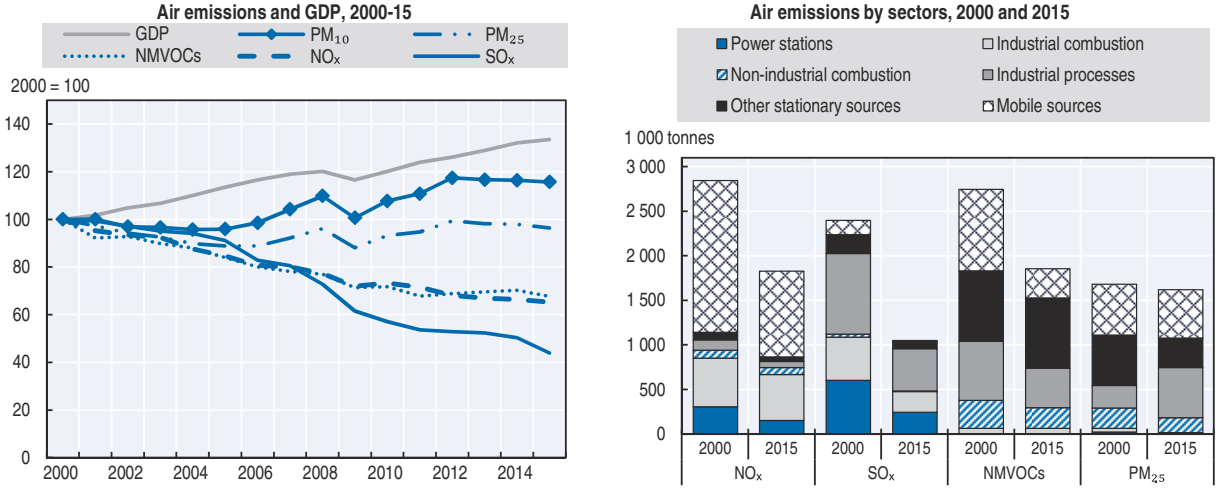
Adaptation implementation in Canada is still in its early stages. The federal government introduced an investment programme of CAD 86 million for 2007-11 to encourage and support climate change action by provinces, territories and municipalities, followed by another CAD 149 million for 2011-16 (OECD, 2015a). Alongside this, a Federal Adaptation Policy Framework was initiated in 2011 to help mainstream climate change into federal decision making. Some individual adaptation measures have been implemented in northern communities. Yet the mainstreaming of climate resilience into decision making remains challenging (see Chapter 5 for examples on wastewater management). The PCF includes a pillar on climate resilience and the federal government announced a significant increase in funding through the establishment of a CAD 2 billion Disaster Mitigation and Adaptation Fund. It also announced the launch of a new Canadian Centre for Climate Services to provide data and information to support planning and decision making related to adaptation. There are considerable knowledge gaps on climate impacts and adaption options for industries and coastal areas, even though one-third of Canada's coastline is moderately to highly vulnerable to sea-level rise (ECCC, 2016b).

3.4. Air emissions and air quality

Air emissions

Canada is among the OECD member countries with the highest emissions of air pollutants both per capita and per unit of GDP (OECD, 2017a). Since 2000, emissions of most air pollutants have decreased at close to the OECD average levels of reductions and with a steady decline in emissions from all sectors. However, emissions of particulate matter (PM_{10}) have increased by 16% since 2000; emissions of fine particulate matter ($PM_{2.5}$) have also slightly risen, following a decline in the first half of the 2000s (Figure 1.7).

Figure 1.7. **Air pollution has been decoupled from economic growth, but intensities remain high**



Source: ECCC (2017), *Air Pollutant Emission Inventory Report 1990-2015*; OECD (2016), *OECD National Accounts Statistics* (database).

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Industry (including industrial processes and combustion) and transport are the largest emitters of most pollutants (Figure 1.7). Together, these two sectors account for approximately 85% of NO_x, 68% of SO_x and 69% of $PM_{2.5}$ emissions. Emissions from both sectors have decreased since 2000. This was mainly owing to the installation of new technology and processes at non-ferrous smelting and refining facilities and the closure of two smelters (which reduced industrial SO_x emissions), as well as stricter trucks and vehicles regulations (which drove down NO_x emissions in particular). The decline in NO_x and SO_x emissions also reflects the shift in electricity generation from coal to natural gas (Section 3.1). Meanwhile, the rise in PM_{10} emissions reflects increasing fossil fuel consumption in transport; particulate matter emissions from construction activities also increased noticeably.

Air quality

Air quality is generally good. In 2015, country-wide mean exposure to $PM_{2.5}$ reached 7.7 micrograms per cubic metre ($\mu g/m^3$), among the lowest values in the OECD and below the WHO guideline value of 10 $\mu g/m^3$ (OECD, 2017b). Notwithstanding, outdoor air pollution is estimated to cause 7 768 deaths per year in Canada (IHME, 2016). Exposure to air pollution varies significantly across the country. Ambient levels of pollutants such as $PM_{2.5}$ are

typically higher in large urban centres close to the Canada-US border, notably in southern Ontario and southern Quebec (Figure 1.8). While exposure to $PM_{2.5}$ in these areas has decreased over the 2000s, more than half of Ontario's population was still exposed to $PM_{2.5}$ levels above the WHO guideline value in 2015; and this share approaches nearly 100% in some urban areas, according to OECD data (OECD, 2017b). This reflects relatively large emissions from transport, residential wood heating and local industries, yet also pollutants from coal-fired electricity-generating stations in the American Midwest. Canadian authorities estimate that nationally approximately 30% of Canadians live in areas where outdoor levels of $PM_{2.5}$ and/or ozone exceed national air quality standards. Trans-boundary air pollution is significant: ECCC estimates that nationwide annual $PM_{2.5}$ concentrations are strongly influenced by US sources, while pollution originating in East Asia affects $PM_{2.5}$ and ozone concentrations in Canada's west coast during the spring and summer season.

Figure 1.8. **Air quality is significantly worse in urban centres along the US border**



Source: OECD (2017), "Exposure to Air Pollution", *OECD Environment Statistics* (database).

Main policies and measures

Prior to 2012, air emissions and quality were primarily managed by provincial governments, though joint work was done on elements such as Canada-wide ambient air quality standards for $PM_{2.5}$ and ground-level ozone. In 2012, ministers of environment, except in Quebec,[5] agreed to implement the Air Quality Management System (AQMS), a comprehensive air quality management programme with four major components: i) national ambient air quality standards; ii) a framework for managing air quality through local air zones and regional air sheds; iii) base-level industrial emission requirements; and iv) a collaborative mechanism to reduce emissions from mobile sources.

Several components of the AQMS have been implemented. Canada strengthened air quality standards for $PM_{2.5}$ and ground-level ozone in 2013, announced a standard for SO_x in late 2016 and is establishing one for NO_x. Provinces and territories agreed to delineate and manage air zones within their jurisdictions with the goal of ensuring the air quality standards are not exceeded. At a regional level, six airsheds were established to facilitate co-ordination of measures to reduce inter-provincial transboundary air pollution. Industrial

emission requirements have been implemented through both regulatory and non-regulatory measures. The 2016 Multi-Sector Air Pollutants Regulations, for example, introduced the first national emission standards for industrial boilers, heaters and engines, and the cement sector. "Codes of Practice" have been published for the aluminium and the iron, steel and ilmenite sectors, and proposed for the pulp and paper industry (see also Chapter 2). Some other heavily-polluting sectors and activities (e.g. refineries, oils sands development) are not regulated to date. Governments agreed to work on mobile sources, focusing on electric vehicles and charging infrastructure, vehicle maintenance and inspection programmes, and options for addressing emissions from in-use diesel fleets. Continued efforts are also needed to manage non-point sources (including particulate matter emissions from construction operation and ammonia emissions from agriculture).

Provinces and territories have implemented additional regulations and other measures to reduce air pollutant emissions within their boundaries. Provinces such as Alberta and British Columbia developed air management strategies. Others, such as Prince Edward Island and Manitoba, primarily use their environmental permitting schemes as the main mechanism to control industrial air emissions. Few provinces use economic instruments to apply the polluter pays principle to air quality management. Ontario has pioneered a trading scheme for NO_x and SO_x emissions, but to date other provinces have not replicated this practice.

Access to information on air quality has improved. Under the AQMS, provinces and territories report annually on air quality and measures taken to implement AQMS in their jurisdictions. Local air zone reports will form the basis for an interactive website that will detail the state of national air quality. The government is partnering with provinces to expand the Air Quality Health Index (AQHI), which provides real-time information about local air quality (an hourly value and a two-day forecast), to all parts of the country.

4. Transition to a resource-efficient economy

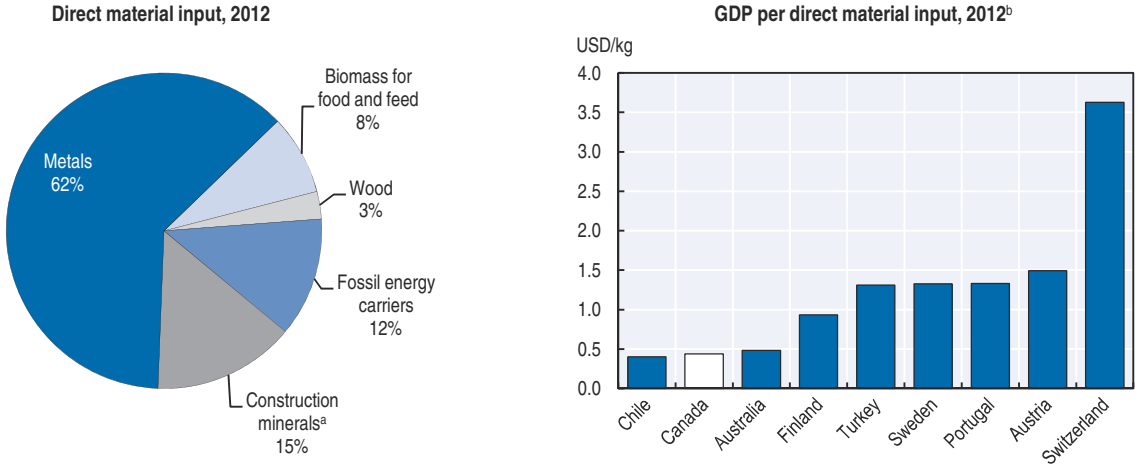
4.1. Material use, waste management and circular economy

Material use

Canada is among the most material-intense economies in the OECD, both in terms of resources (measured by weight) consumed per capita and of resources needed to generate a unit of GDP (OECD, 2017c). This partly results from the extensive use of heavy materials in the Canadian economy, such as minerals and metals (Figure 1.9). Such use of heavy materials, in turn, reflects the country's vast resource endowments and a strong mining and construction industry. Yet, even when compared to other OECD economies with high reliance on minerals and metals, Canada displays low material productivity (Figure 1.9). This hints at room for improvement, including for encouraging greater re-use and recycling of materials.

Canada is the second largest extractor of material resources among OECD member countries after the United States. Alongside Australia and Norway, it is also one of the few net materials exporters. Canada exports nearly one-third of its extracted biomass, and nearly two-thirds of extracted fossil fuels. Fossil fuels accounted for nearly half of total material exports in 2012, followed by metals (31%) and biomass (25%). Total material exports decreased dramatically during the global financial crisis in 2008-09; they recovered in the following years, but remain below pre-crisis levels.

Figure 1.9. **Canada is among the most material-intense economies in the OECD**



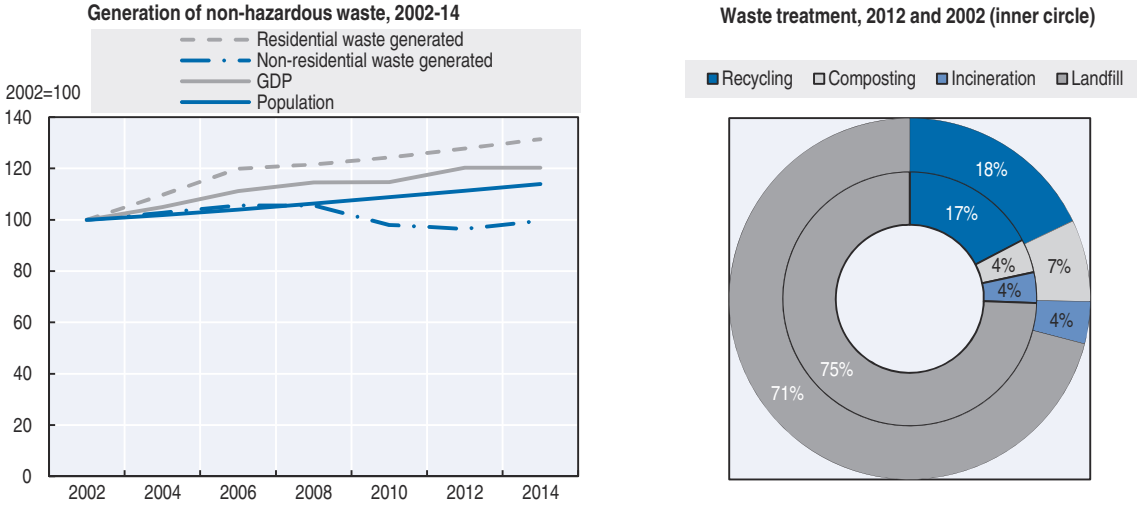
a) Construction minerals contain small amounts of non-metallic minerals used for purposes other than construction.
b) Group of OECD countries with highest relative shares of minerals and metals for use in the economy.
Source: OECD (2017), "Material Resources", *OECD Environment Statistics* (database).

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Waste generation and treatment

Canada generated approximately 34 million tonnes of non-hazardous waste in 2014, or about 950 kg per capita.[6] Waste generation increased by about 11% between 2000 and 2014. It was driven entirely by residential waste, which increased faster than GDP and population (Figure 1.10). On a per capita basis, residential waste increased by 15% over 2002-14, compared to a general decrease in the OECD. Non-residential waste generation (including industrial, commercial, institutional and construction waste) rose during the first half of the 2000s, but has decreased since 2008. It accounted for 57% of total generated waste in 2014, while residential waste made up the remaining 43% (Statistics Canada, 2017b).

Figure 1.10. **Recycling has increased, but remains low**



Note: Proxied by the sum of total diverted material and total disposed material. Data on diverted material exclude waste that is recycled on-site. No data are available for Yukon, Northwest Territories and Nunavut, and Prince Edward Island.
Source: Statistics Canada (2016), *Materials Disposed and Diverted* (Tables 153-0041 and 153-0043), *CANSIM* (database).

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More than two-thirds of produced waste is sent to landfill (Figure 1.10), a share much higher than the OECD average. The share of recovered material (e.g. recycled or composted) has increased from 21% to 25% over 2000-12, but it remains small and seems to improve less rapidly than in most other OECD member countries (although lack of comparable data hampers direct benchmarking). Larger composting of residential organic waste and, to a lesser extent, recycling of plastics and paper, drove the increase in waste diversion. No significant improvement has been made in the recycling of non-residential waste (Statistics Canada, 2017b). Recycling rates remain low in some major waste generation sectors such as construction and demolition waste. They are equally low for material streams for which recycling technologies and markets generally exist such as metals (Giroux, 2014).

Strengthening the policy framework

Canada has no national target on waste reduction and diversion, although several provinces have established quantified goals. Regulations and incentives for waste reduction and recovery vary widely across provinces, which is reflected in highly heterogeneous performance in waste management. For example, Nova Scotia, which features the highest waste recovery rate, has banned landfilling of material for which recovery infrastructure is in place. It has also installed a deposit-refund scheme for beverage containers. Some other provinces tax landfilled waste to encourage waste diversion. Northern communities face particular waste management challenges, including difficulties in segregation and storing of environmentally-harmful products, open burning and outdated disposal infrastructure.

A welcome step, the Canadian Council of Ministers of the Environment (CCME) adopted the Canada-wide Action Plan for Extended Producer Responsibility in 2009 with the aim to harmonise material recovery policies and programmes across jurisdictions. By 2014, the number of product categories covered by legislated extended producer responsibility programmes or requirements had almost tripled. It now covers half of categories identified in the 2009 action plan (CCME, 2014). These efforts should be continued, with a priority on major waste streams from the industrial, commercial and construction sectors. In 2014, federal, provincial and territorial environment ministers further adopted a shared vision and Action Plan for Waste under the auspices of the CCME. These could serve as a basis to identify, diffuse and scale-up good practices across the country, which will be necessary to improve national performance. Canada will also need to strengthen the availability and comparability of data. This will enable the country to monitor and track progress, as well as to improve assessment of the effectiveness of waste policies and instruments. Data gaps are particularly large for industrial and commercial waste.

4.2. Chemicals management

Canada was one of the first countries to systematically begin to address the risks of legacy chemicals. Building upon a priority-setting exercise that involved 23 000 chemicals and identified 4 300 substances for further review, Canada adopted the 2006 Chemicals Management Plan (CMP) with a commitment to review these substances by 2020. To date, approximately 70% of these priority substances have been assessed. Of these, it has found more than 350 substances to be harmful to human health and/or the environment; more than 80 risk management actions have been put in place. Meanwhile, about 5 000 new substances (used since 2006) have been reviewed. Future work until 2020 will focus on addressing the remaining 30% of priority substances identified in 2006, while continuing to manage substances identified previously. A new emphasis under this third phase is to

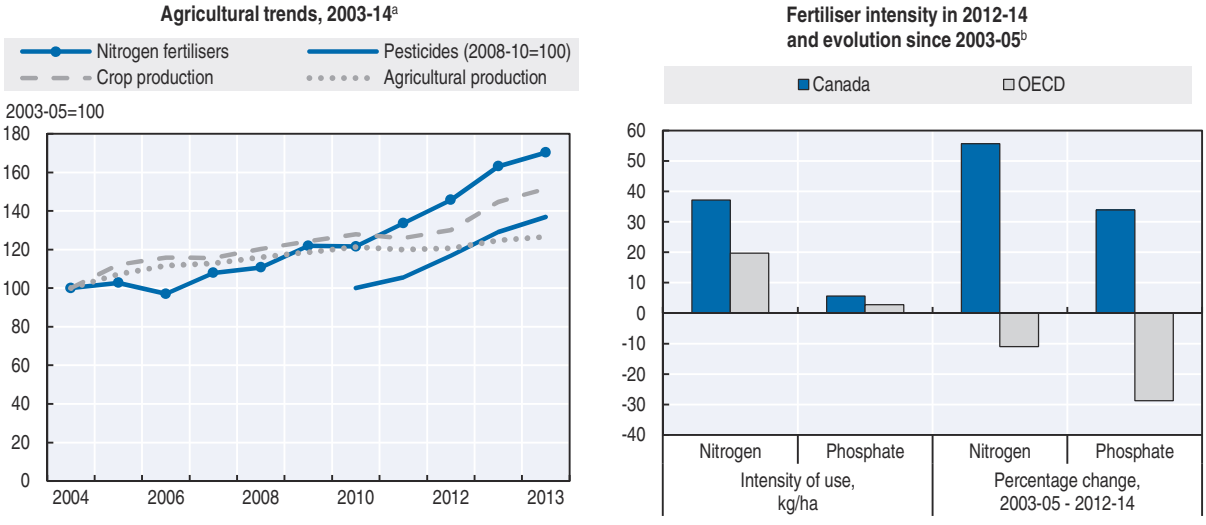
address substances using "fit-for-purpose" assessment approaches, which aims to help focus efforts on substances of highest concern, and to ensure that engagement of stakeholders is strategic and targeted.

Under the CMP, Canada conducts a series of environmental monitoring programmes, including ecological assessments that measure specific chemicals in outdoor air, water, sediments, fish and birds, as well as in landfills and wastewater treatment plants. Further, human health bio-monitoring activities study citizens' exposure to environmental chemicals such as lead, cadmium and mercury, including exposure of vulnerable populations such as pregnant women and Arctic populations. These assessments help establish trends in chemical pressures, inform the risk assessment and risk management activities under the CMP, and evaluate the impact of risk management activities.

4.3. *Agricultural inputs and nutrient balance*

The intensification of Canada's large agricultural sector has increased pressures on ecosystems and biodiversity over the past two decades. Soil quality has improved, largely owing to better land management practices such as reduced tillage. However, wildlife habitat has declined in some areas and the risk to water quality has increased across Canada. The latter reflects a quite significant increase in the application of fertilisers and pesticides that reflects an intensification in production, a shift from livestock and to crop cultivation, and continued adoption of no-till and reduction of fallow management (which increased the annual crop land in production) (Clearwater et al., 2016). The consumption of nitrogen fertilisers has increased faster than in any other OECD member country; about twice as fast as total agricultural production since the early 2000s (Figure 1.11). Fertiliser intensity (application per hectare of agricultural land) has increased, compared to a decrease in the OECD as a whole (Figure 1.11). Pesticide use increased by about 40% over the past 5 years, while the share of organic agriculture remains small (at 1.5% of agricultural land in 2015) (FiBL, 2017). Provinces are increasingly mandating nutrient management plans and some require buffer strips around

Figure 1.11. **The use of agricultural chemicals grew more than agricultural output**



a) Based on three-year moving average data. Data refer to apparent consumption of fertilisers and pesticides sales.
b) Intensity of use of fertilisers on agricultural area.
Source: FAO (2017), *FAOSTAT* (database); OECD (2017), *Environmental Indicators for Agriculture* (database).

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water courses and groundwater sources to limit nutrient leaching (OECD, 2015b). However, more needs to be done to reduce agriculture's impact on water quality.

Regulatory and management practices for pesticides were found to be insufficient to avoid risks to environment and health of Canadians (OAG, 2015). Canada has made extensive use of "conditional registrations" for pesticides whose risks and values are not fully known. Several products have stayed on the market even long after conditions for risk assessments were not met. The re-evaluation for pesticide introduced before 1995 has progressed only slowly, while cancellations of registrations for pesticides found to pose unacceptable risks tended to take a long time.

5. Managing the natural asset base

5.1. *Physical context and land use*

Canada is the world's second largest country, covering nearly 10 million km^2. Canada has more inland waters that any other country in the world; they cover some 9% of the country's total surface area. Forests cover 38% of total land area; land used for agriculture has decreased slightly to about 7%; urban and industrial land cover about 1%. Geography, climate and land use varies widely across the country. A broad belt of coniferous forest (essentially boreal forest) crosses Canada from east to west; agriculture mainly concentrates in the south and southwest; and tundra and permanent ice dominate Canada's far north (covering roughly a quarter of total land area).

5.2. *Biodiversity and ecosystems*

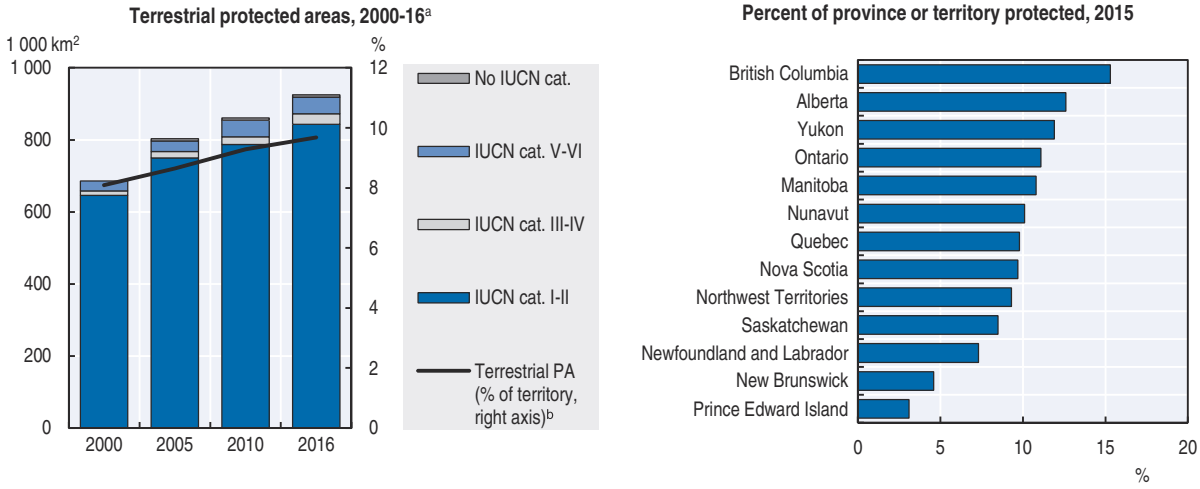
Canada harbours a great diversity of terrestrial and marine ecosystems. It hosts about 9% of the global forest area and one-quarter of remaining wetlands, as well as the world's longest coastline. Canada's territory comprises large tracts of undisturbed wilderness, as half of its landscape remains free from human infrastructure. Much of this is, however, in the remote north. Closer to human activity, Canada's natural environment is pressured by habitat loss and fragmentation, invasive species and disease, exploitation of natural resources, pollution and climate change. Wetlands and grasslands continue to be lost, even if the rate of loss has slowed. The rate of deforestation is low at a national level, but significant in some areas. Coastal zones in developed areas are degrading from habitat modification, erosion and sea-level rise (CCRM, 2010).

Canada has advanced biodiversity-related policy and legislation. Key milestones include the 2006 Biodiversity Outcomes Framework, which describes desired long-term outcomes from national and sub-national biodiversity strategies and plans, and the 2020 Biodiversity Goals and Targets, adopted in 2015 in response to the UN Convention for Biological Diversity Strategic Plan for Biodiversity 2011-20.[7] A federal-provincial-territorial action framework to develop policies (i.e. going beyond common objective setting) could help ensure that each jurisdiction contributes to the common goal. Canada has not signed the Nagoya Protocol on Access and Benefit Sharing (ABS). No comprehensive system governs access to genetic resources and associated traditional knowledge or facilitates the sharing of benefits arising from their use. However, some federal, provincial and territorial laws and regulations cover some elements of ABS, and work on a domestic implementation strategy for ABS is ongoing.

Protected areas

The terrestrial area under protection increased over 2000-16 from 8.1% to about 10% (Figure 1.12), the fourth lowest value among OECD member countries. Under the UN Convention for Biological Diversity, Canada is committed to conserve at least 17% of terrestrial areas and inland water by 2020 (one of the so-called Aichi targets). The country will need to considerably accelerate the pace of establishing protected areas or other effective area-based conservation measures to achieve this commitment. Nearly half (46%) of the protected area in Canada is under federal jurisdiction, with the remainder administered at provincial, territorial or local levels. The percentage of land under protection varies considerably across provinces, ranging from 3% in Prince Edward Island to 15% in British Columbia (Figure 1.12). Only New Brunswick and Alberta have increased its protected area by more than 1% in recent years. Several provinces are working on the establishment of new protected areas. For example, Quebec and Ontario have committed to protecting half of their northern regions, but progress to date has been slow. Alberta committed to the establishment of new protected areas that would expand its current protected areas network by 50%.

Figure 1.12. **Protected area remains below the Aichi target**



a) According to IUCN Protection Areas Categories System: I-II Strict nature reserve, Wilderness area, National park; III-IV Natural monuments/feature, Habitat/species management area; V-VI: Protected landscape/seascape, Protected area with sustainable use of natural resources.
b) Excluding overlaps.
Source: ECCC (2017), Canadian Environmental Sustainability Indicators: Canada's Protected Areas; OECD (2017), *OECD Environment Statistics* (database).

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The representativeness of different ecosystems in Canada's protected area network has improved, but gaps remain. For example, while the Rocky Mountains have some 15% of their area protected, eco-zones in southern Ontario and Quebec have less than 2% protected. Until 2017, Canada did not have a framework to guide the development and implementation of a terrestrial protected areas network, which would help strategically enhance ecosystem representativeness. It also lacks a nation-wide assessment. Almost three-quarters of protected areas are smaller than 10 km^2, making it important to provide good ecological connectivity (e.g. through biodiversity corridors) and to integrate smaller protected areas into larger ones to safeguard species' habitat needs and full functioning of ecosystem processes. In southern Canada, this will require extensive restoration work (CPAWS, 2015). There are encouraging examples of landscape-level management (such as Alberta's new

approach to land-use planning; see Chapter 2), but its application overall remains very limited and should be scaled up. A welcome step, Canada recently launched the federal-provincial-territorial initiative "Pathway to Canada Target 1" as a framework to guide the development and implementation of a terrestrial protected area network to meet the 2020 target. This provides an opportunity to strategically enhance ecosystem representativeness.

Nearly all protected areas report deficiencies in capacity and resources for site management and monitoring. Many protected areas operate without up-to-date management plans. Most government organisations for protected areas report on programme-related performance measures, but few assess effectiveness. This makes it difficult to determine whether protected areas achieve desired conservation objectives (ECCC, 2016c). Many protected areas have formal arrangements to engage organisations, Indigenous communities and the general public. Several habitat conservation and stewardship programmes support biodiversity conservation on private lands. For example, the Ecological Gifts Programme provides tax incentives for the donation of ecologically sensitive land. Stewardship activity is increasing, both in number and types of initiatives and in participation rates. However, their effectiveness in conserving and improving biodiversity and ecosystem health has not been fully assessed.

Marine protected areas covered approximately 0.9% of Canada's marine and coastal areas in 2015. This was up from 0.4% in 2000, with some of the increase explained by better reporting. Most (80%) are administered at the federal level, with provincial protected areas making up the rest. In 2016, aligning with the Aichi target, the government committed to protecting 5% of Canada's marine and coastal areas by 2017, and 10% by 2020. In 2011, federal and provincial governments agreed on a pan-Canadian framework for Canada's network of marine protected areas. Quebec is the only province with a quantified target for marine protected areas.

Species

There are about 80 000 known species in Canada and likely many more that have not yet been identified. The status of wildlife species is assessed every five years. In the latest assessment in 2015, nearly 30 000 species were assessed, of which nearly 1 700 species were listed as potentially at risk (CESCC, 2016). The total number of species assessed as extirpated or at risk is over 500. Recovery or management plans are in place for about 470 species. However, the population trends have improved for only one-third of species addressed by such a plan. Efforts to reverse long-term fisheries declines have been largely unsuccessful (CCRM, 2010).

Forests

With nearly 350 million ha, Canada has the third-largest forest area in the world, after the Russian Federation and Brazil. Forest cover per capita is among the highest in the world. The boreal forest that spans Canada is said to be the largest continuous forest ecosystem and the most intact forest remaining on Earth. Canada's total forest area has remained relatively stable since 2000, at 38% of total land area (OECD, 2017d). Deforestation (the permanent loss of forest cover) is relatively low and has remained fairly stable since 2000 (averaging at around 45 000 ha or 0.01% of total forest area annually). Much of this land is being converted for agricultural use; oil and gas development accounted for one-quarter of deforested land in recent years.

Canada is internationally recognised for sound standards for sustainable forest management. By law, all forest harvested on public lands (94% of total forest area) must be

regenerated. More than 80% of forest available for timber harvesting is certified as sustainably managed. About 0.5% of forest is harvested annually – less than the area burned by forest fires (1.2%) or damaged by insects (2.5%) (NRCan, 2014).

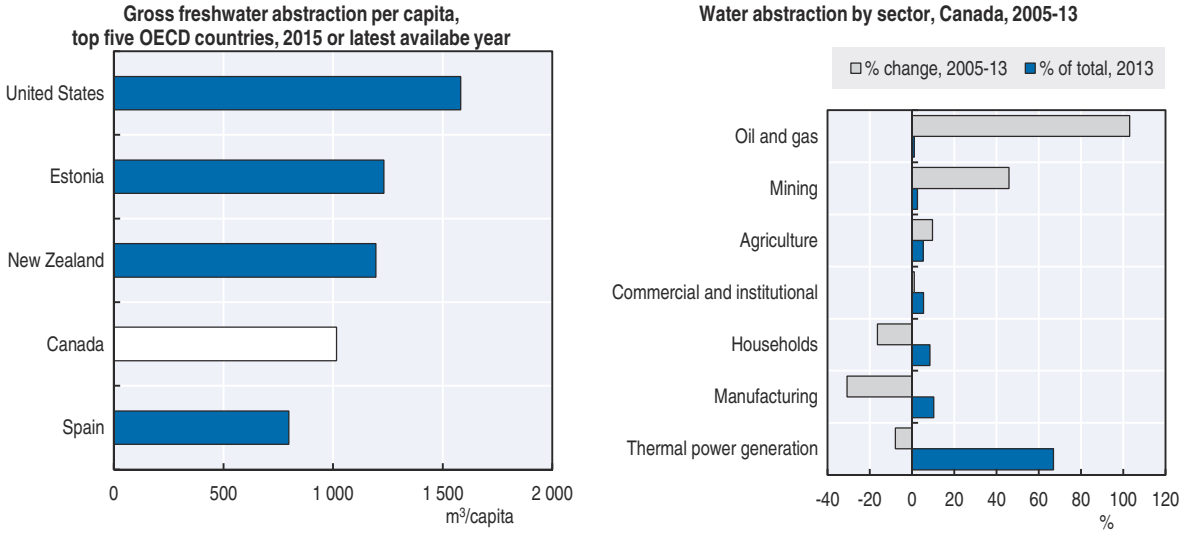
5.3. Management of water resources

Water resources

Canada is a water-abundant country, possessing about 7% of the world's renewable resources. As a result, water stress, defined as the ratio of water consumption over total renewables resources, is among the lowest in the OECD (see Basic Statistics). However, water resources are unequally distributed. About 60% of freshwater supply flows northward, away from population centres. Several areas along the southern border have faced high threats to water availability, with abstraction exceeding 40% of available resources (compared to the national average of 1%) (ECCC, 2017). At the same time, higher-than-average rain- and snowfall has led to flooding of agricultural lands and overflows of water management systems in urban areas. Water availability challenges will intensify as population and the economy grow and the climate changes (Warren and Lemmen, 2014).

Canada is one of the largest water consumers in the OECD. Water use per capita is one of the highest in the OECD (Figure 1.13), and nearly 25% above the OECD average. This reflects low water prices and a "myth of water abundance" in Canada (also see Chapter 5), which results in relatively weak water conservation. Natural resource sectors, such as agriculture, oil and gas, mining and thermal power generation, account for three-quarters of national water consumption. Water consumption decreased by 9% between 2005 and 2013, driven mostly by reduction in thermal power generation and lower demand of the manufacturing sector. Residential water consumption has also dropped, driven by improved technology and water conservation programmes. The largest increase occurred in the mining and oil and gas industry (Figure 1.13).

Figure 1.13. **Canada is among the largest water consumers in the OECD**



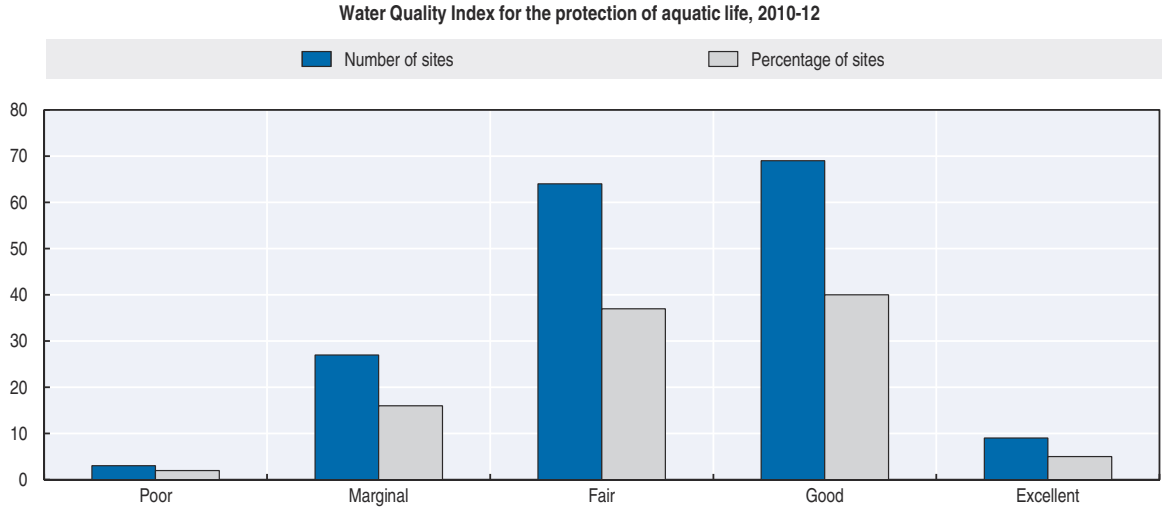
Source: ECCC (2016), "Water Withdrawal and Consumption by Sector"; OECD (2017), "Water: Freshwater Abstractions", *OECD Environment Statistics* (database).

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Water quality

Water quality is generally fair to good in Canada. However, nearly one-fifth of monitored water sites register marginal or poor water quality (Figure 1.14). Major threats to freshwater quality include nutrient pollution from agricultural and urban wastewater sources, persistent toxic substances and emerging chemicals of concern from urban and industrial sources.

Figure 1.14. **Water quality is unsatisfactory in more than half of monitored freshwater sites**



Note: Freshwater quality was assessed at 172 sites on select rivers throughout 16 of Canada's drainage regions where human activity is most intensive using the Canadian Council of Ministers of the Environment's Water Quality Index for the protection of the aquatic life. Water quality is considered "excellent" when ambient water quality never, or very rarely (95-100), exceeds water quality guidelines for any selected parameters. Water quality is rated "good" when water quality measurements rarely exceed guidelines and/or they do it by a narrow margin (80-94.9), "fair" when they sometimes exceed guidelines and/or do so by a wide margin (65-79.9), marginal when they often exceed guidelines and/or do so by a considerable margin (45-64.9). When water quality is rated "poor", water quality measurements usually exceed their guideline and/or exceedances are large (0-44.9).
Source: Environment and Climate Change Canada (2015), *Freshwater Quality in Canadian Rivers Indicator* (dataset).

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Water management

Water allocation regimes vary widely across the country. Not all provinces have established clear principles for water allocation or priority uses in case of severe or prolonged water stress. Few jurisdictions have systems for effective water re-allocation in times of water stress. Some provinces charge for water abstraction, yet charges are often low and tied neither to water scarcity nor to the opportunity costs associated with proposed water uses (OECD, 2015c; Renzetti, 2017). Several provinces embarked on reform processes of their water allocation regimes. For example, Ontario and British Columbia have raised their fees for water permits; Alberta has provided permit holders with the limited ability to trade water withdraw rights. Canada should continue to review whether current allocation regimes are fit for the challenges of population and urban growth, expanding natural-resource based activities and the effects of climate change. Canada should also support the development of pollution charges in watersheds that endure point-source pollution.

Provinces regulate water quality separately from water allocation. Provincial governments have relied almost exclusively on setting quantitative limits on discharges to meet water quality objectives. This contrasts with a number of other jurisdictions in the OECD that have followed the polluter pays principle and adopted fees and charges to promote improved water quality. In an interesting pilot, Ontario is investigating the viability of a water quality trading programme to reduce phosphorous and nitrogen loadings in Lake Simcoe, a popular lake north of Toronto.

Public water and sanitation services

The majority of Canadians (about 75%) are connected to a municipal water supply and sewerage treatment systems. The remaining 25%, mostly in rural or remote areas, draw their water directly from a surface or groundwater source, or are served through a commercial water provider. The provision of safe drinking water in rural and remote communities, notably in First Nations reserves, remains a serious challenge. In 2015, 10% of households in Canada reported being notified of a "boil water" advisory due to water quality concerns (Statistics Canada, 2015). Significant investment helped increase the share of on-reserve First Nations drinking water systems with low risk ratings from 27% to 57% between 2009-11 and 2014-15. However, a non-negligible number of Canadian communities in Canada still lack access to safe and reliable drinking water (Renzetti and Dupont, 2017).

Even though residential water consumption has decreased in recent years, it remains one of the highest in the OECD, on a per capita basis. There is large regional variation, however. In 2009, residential water consumption reached nearly 400 litres/day/per capita in Newfoundland and Labrador (where most residents pay a flat charge). This is almost twice as much as the approximately 220 litres/day/per capita consumed in Manitoba and Alberta, for example (where consumers pay by volume) (Renzetti, 2017). Nationally, households paying by volume consume about an estimated 70% less water than those paying a flat charge (EC, 2011). In many municipalities, charges are too low below the cost of water and sewerage services to ensure long-run financial health of these systems. With the exception of Ontario, Canadian provinces lack regulation on full-cost accounting cost-recovery for municipal water supply and sanitation services (see also Chapter 5).

Recommendations on air, materials, water and biodiversity management

Air pollution

- Develop standards for all heavily polluting sectors and activities (e.g. refineries and oils sands development) under the Air Quality Management System; continue to improve knowledge of the relative health impacts and associated costs of the individual components of $PM_{2.5}$ pollution to allow for more effective mitigation actions; continue efforts to manage non-point sources; continue to pursue co-operation with the United States and other countries affected by, or contributing to, transboundary air pollution.

Materials, waste management and circular economy

- Continue to develop extended producer responsibility schemes, prioritising key waste-generating sectors (e.g. from the industrial, commercial and construction sectors) and waste streams with large recycling potential (e.g. metals); ensure coherence and, where possible, harmonisation of schemes across jurisdictions, while strengthening the availability and comparability of data to monitor and track progress.
- Encourage waste prevention and recovery of materials not covered under extended producer responsibility schemes (e.g. organic waste) by: i) expanding landfill charges; ii) making greater use of waste collection charges for household waste; iii) raising awareness among citizens and businesses; and iv) considering the possibility of incentives (e.g. fiscal incentives) for recycled products to support the development of recycling markets and infrastructure; facilitate the diffusion of best practices across jurisdictions, while paying particular attention to improving waste practices in northern communities.

Recommendations on air, materials, water and biodiversity management *(cont.)*

Water management

- Consider the introduction of water abstraction charges, in particular in watersheds where water is scarce or competition to access the resource intensifies; continue efforts to reform water allocation regimes, with a view to establish abstraction caps, define priority users and build mechanisms for effective water re-allocation in regions facing water scarcity.

Biodiversity management

- Accelerate efforts and collaboration across jurisdictions to conserve at least 17% of terrestrial areas and inland water by 2020; expand protected areas in the southern part of the country; and substantially increase the total area of marine and wetland ecosystems under protection.
- Develop and implement a national policy on access and benefit sharing of genetic resources to lay the ground for accession to the Nagoya Protocol.

Notes

1. The Natural Resources Satellite Account measures the importance of natural resource activities in the Canadian economy. These are defined as products and services originating from naturally occurring assets used in economic activity. These assets comprise mineral and energy resources, water, natural timber, and aquatic and other natural biological resources. They do not include intensively cultivated biological resources, such as crops and aquaculture.
2. TPES is the total supply of energy that is consumed domestically, either in energy transformation (e.g. in oil refining) or in final consumption by end-users.
3. TFC is the final consumption by end-users (i.e. in the form of electricity, heat, gas, oil products, etc). TFC excludes fuels used for electricity or heat generation and other energy industries (transformations) such as refining.
4. Fugitive emissions are releases of gases and vapours emitted from pressurised equipment. Emissions can be either unintended (e.g. through leaks) or released from industrial activities. In Canada, more than half of fugitive emissions stem from the venting of natural gas; about 30% are unintended emissions from upstream oil and gas; 10% is from flaring of oil and gas.
5. Quebec did not sign-on to the AQMS, given that it has its own Clean Air Regulation, but did agree to collaborate with jurisdictions on developing other elements of the system.
6. The estimate for generated waste is the sum of waste disposed (i.e. landfilled or incinerated in plants with energy recovery) and waste diverted (i.e. treated in composting, anaerobic digestion, material recovery and recycling facilities). Data include waste exported to other countries, but exclude waste managed by the waste generator on site.
7. The 2020 Biodiversity Goals and Targets were endorsed by all provinces and territories except one. Quebec has acknowledged, but not endorsed, 2020 Biodiversity Goals and Targets. It argues that it develops and implements its own instruments for biodiversity conservation and for achieving the international targets on its territory.

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PART I

Chapter 2

Environmental governance and management

Canada has improved the effectiveness of multi-level environmental governance and enhanced the engagement of Indigenous peoples in environmental decision making. However, more needs to be done to build on recent progress in these areas and adopt good international practices in environmental assessment and permitting. This chapter analyses Canada's environmental governance system, including the institutional and regulatory frameworks and measures to ensure compliance with environmental law. It also assesses progress in promoting environmental democracy through public participation, access to information, justice and education.

1. Introduction

Canada is re-evaluating its environmental policies and regulations in light of the more ambitious goals of the current government. This process emphasises strengthening instruments of environmental governance, particularly those related to performance management. The Cabinet Committee on Agenda, Results and Communications chaired by the Prime Minister has embraced the concept of "deliverology" aimed at achieving measurable outcomes in the federal government's priority policy areas, one of which is climate change. The outcome focus of environmental governance requires progress in information management, compliance assurance and environmental democracy, among other areas.

Improved partnerships with provincial, territorial and municipal governments are one of the key priorities of the federal government in the field of environment (PMO, 2017). The latest example of a successful concerted inter-jurisdictional effort is the development of the pan-Canadian Framework on Clean Growth and Climate Change, announced by Canadian first ministers in December 2016 (Chapters 3 and 4). Equivalency and other types of agreements between the federal and provincial or territorial governments have addressed many, though not all, issues of overlapping environmental responsibilities. At the same time, many good practices emerging at the sub-national level could be usefully shared with other jurisdictions.

The Prime Minister's declaration that "no relationship is more important to me and to Canada than the one with Indigenous peoples" (PMO, 2017) reflects a dramatic policy change with respect to Canada's First Nations, Inuit and Métis communities. For many years, Indigenous peoples have felt that they have had no opportunity to meaningfully participate in environmental decision making. They have also felt subject to "environmental racism": damage to Indigenous communities from natural resource development projects vastly exceeded the benefits. With Canada's adherence to the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), the implementation of Indigenous peoples' rights has become key to enhancing the country's environmental democracy, particularly with respect to land use.

2. Institutional framework for environmental governance

Canada, the second largest country in the world in terms of land area, is a federation composed of ten provinces and three territories. While provinces exercise constitutional powers in their own right, territories exercise delegated powers under the authority of the Parliament of Canada.

The Canadian Constitution defines the exclusive powers of federal parliament and provincial legislatures. The environment, which is not specifically listed in the division of powers in the Constitution, is an area of concurrent jurisdiction. A particular pollution problem may fall within the jurisdiction of both the federal and provincial/territorial levels of government. Each may view the problem from a different perspective or choose to adopt differing instruments of control.

Provinces have the leading role in environmental protection. They regulate air emissions, water and wastewater treatment and discharges, waste management (with the exception of transboundary movement of waste), land use, development of natural resources and protection of wildlife. However, the federal government's constitutional authority over criminal law, fisheries, shipping and navigation has been used to justify federal environmental legislation in many areas. Responsibility for the environment in the territories varies between jurisdictions. In Yukon and the Northwest Territories, land, water and resource management falls under the responsibility of the territorial government, whereas the federal government has this responsibility in Nunavut. There are several areas of duplication between federal and provincial responsibilities, including environmental assessment, water quality management and biodiversity protection. This duplication leads to occasional tensions between the two levels of government and may need further clarification. For example, some projects can be subject to environmental assessment under both federal and provincial law.

Municipalities are vested with powers by the provinces and hold only an indirect relationship with the federal government. Municipalities are generally responsible for providing environmental services (water supply, sanitation and waste management). However, many are also becoming active in such matters as development of contaminated land and regulating effluent discharge into municipal sewage systems. Still, municipalities collect only a small share (less than 10%) of the total tax revenue. This raises the issue of "unfunded mandates", i.e. the gap between the responsibilities and resources available to carry them out.

2.1. National institutions and horizontal co-ordination

The Minister of Environment and Climate Change is accountable to parliament for the administration of the Canadian Environmental Protection Act (CEPA, 1999). In 2014, Environment and Climate Change Canada (ECCC) became responsible for the administration and enforcement of most of the pollution prevention provisions under the Fisheries Act. The Department of Fisheries and Oceans remains responsible for matters related to aquaculture and aquatic invasive species. The Canadian Environmental Assessment Agency (CEAA) promotes, monitors and facilitates compliance with the Canadian Environmental Assessment Act (2012).

Within the federal government, topic-specific interdepartmental committees at the senior management level co-ordinate environmental matters. Among other responsibilities, they provide direction and guidance on key issues associated with the development and implementation of Federal Sustainable Development Strategies (Chapter 3). Similar horizontal co-ordination mechanisms exist at the provincial level. These include the Natural Resource Board of British Columbia, Alberta's Natural Resources Conservation Board and Quebec's Inter-ministerial Committee for Sustainable Development. Not all of them function well, however. For example, Quebec's committee meetings are attended by less than half of its members (Vérificateur Général du Québec, 2017).

2.2. Sub-national institutions and vertical co-ordination

Every jurisdiction has an environmental ministry or agency, but environmental responsibilities can be widely shared within each government. Some jurisdictions (e.g. Quebec, Ontario, New Brunswick) have distinct departments/ministries responsible for some aspects of wildlife management and conservation. As in the federal government, the mandates of other

sub-national departments or ministries can also have a significant environmental component, such as those responsible for natural resources, fisheries or health.

The main federal/provincial/territorial body addressing national environmental issues is the Canadian Council of Ministers of the Environment (CCME). The CCME, comprised of environment ministers from the federal, provincial and territorial governments, is chaired by 1 of the 14 jurisdictions according to a set annual rotation. It traditionally addresses issues related to air, water, waste and contaminated sites and has recently added climate change to its agenda. It has done a great deal to harmonise federal and provincial regulations in these areas. Ministers generally meet in person on an annual basis, whereas the CCME's secretariat (based in Winnipeg) functions continuously. The CCME is supported by numerous topic-specific sub-committees: the Air Management Committee; the Climate Change Committee; the Soil Quality Guidelines Task Group; the Waste Management Task Group; and the Water Management Committee. The collaborative development of the Air Quality Management System (Section 3.2) was the CCME's major recent success.

Other key permanent vertical co-ordination bodies include:

- The annual Energy and Mines Ministers' Conference – a forum for Canada's federal, provincial and territorial governments to collaborate and align efforts on shared energy priorities related to energy innovation, research and development, and the impact of energy development and use on climate change.
- The Canadian Council of Forest Ministers – a mechanism for federal, provincial and territorial ministers responsible for forests to advance shared priorities, including innovation, forest-based Indigenous economic development, forest fire management and climate change.
- The Committee on Health and Environment (CHE) – established in 2003 to enhance strategic collaboration between health and environment sectors across jurisdictions. The CHE was revitalised in 2016 to consider such issues as climate change and environmental assessment.
- The Canadian Council of Resource Ministers – a grouping of ministerial forums for forests, fisheries and aquaculture, parks, endangered species and wildlife. Following a long period of inactivity in 2006-15, an ad hoc committee of ministers responsible for conservation, wildlife and biodiversity has recently resumed its work.

Federal environmental authorities also enter into various types of agreements (substitution and equivalency agreements, memoranda of understanding, administrative agreements and collaboration agreements) with their provincial and territorial counterparts. A main objective of such agreements is to reduce duplication of environmental management responsibilities between the two jurisdictions (see Chapter 5 for a discussion of equivalency agreements for urban wastewater management). Alberta, British Columbia, Manitoba, Newfoundland and Labrador, Ontario, Quebec, Saskatchewan and Yukon have entered into co-operation agreements with the federal government that provide for a single, co-operative environmental assessment process where both federal and provincial/territorial statutes require such an assessment of a proposed project. However, the elaboration of such agreements requires substantial time and resources. The PCF is a prominent recent example of an issue-specific inter-jurisdictional agreement that commits all actors to work together towards common targets, but recognises that sub-national governments will use different approaches to achieve them. Another example is the 2014 agreement between the federal government and Ontario on the management of the Great Lakes, with annexes on the engagement of Indigenous peoples.

Canada has a unique relationship with its Indigenous peoples (First Nations, Inuit and Métis), which is reflected in its Constitutional Act. Canada implements 26 modern treaties – Comprehensive Land Claim Agreements – and 4 self-government agreements signed with Indigenous peoples since 1973, covering over 40% of the country.[1] These constitutionally protected treaties are negotiated between an Indigenous group, the federal government and the province or territory. They are implemented through legislation and provide certainty for all parties about the ownership, use and management of land and natural resources. They address issues such as harvesting and sub-surface rights, resource revenue sharing and environmental management. These agreements have established new governance regimes that have significantly enhanced Indigenous communities' influence over land, wildlife and resource decisions.

In addition, the federal governments of Canada and the United States have implemented over 40 international agreements for the management and protection of environmental quality and ecosystems in the border area. These include the Great Lakes Water Quality Agreement (1972, last amended in 2012) and the Air Quality Agreement (1991). There are over 100 additional such agreements between American states and Canadian provinces. They include the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement between eight states and two provinces signed in 2005. Quebec's cap-and-trade system for greenhouse gas (GHG) emissions, introduced in 2012, was linked to that of California in 2014 (Chapter 4). This close and effective cross-border collaboration should be preserved and encouraged.

The Council of the Federation is the premier-led sub-national intergovernmental forum on areas of mutual concern, including environmental issues; the federal government does not participate. In 2015, the Council adopted the Canadian Energy Strategy to enable a co-operative approach to sustainable energy development. This includes support for clean energy technology and innovation, and enhancing energy efficiency policies and mechanisms. Municipalities participate in sub-national forums to discuss matters of shared concern, including cross-border environmental issues, but are usually not part of federal-provincial co-ordination mechanisms. Several provinces (e.g. Alberta) have horizontal collaboration between smaller municipalities on environmental matters in the form of "regional commissions" on water (shared water supply services or wastewater treatment plants) and waste management.

The federal government provides funding for about half of capital investments into municipal environmental infrastructure (water supply, sanitation, waste management) and contributes to its operating costs. There is also endowment funding to support sustainable community development through the Green Municipal Fund (GMF) under the Federation of Canadian Municipalities. The GMF disburses grants to develop plans and conduct feasibility studies, as well as low-interest loans, usually in combination with grants, to implement capital projects in the fields of land remediation and development, energy, transportation, waste and water (GMF, 2017). However, municipalities widely regard the GMF disbursement process as administratively heavy and time- and resource-consuming.

Information sharing across jurisdictions is an important challenge. Reporting arrangements that are part of collaborative mechanisms between levels of government (e.g. under the Air Quality Management System, Section 3.2) improve data collection and use, even though they sometimes involve complex administrative procedures. Improving standardisation of both data collection and management, and inter-jurisdictional exchange of information, is important to better support decision making in Canada's multi-level governance context.

3. Regulatory requirements

The Canadian Environmental Protection Act (CEPA, 1999) is the principal federal environmental statute. It governs a variety of environmental activities falling within federal jurisdiction such as the regulation of toxic substances, inter-provincial and international movement of hazardous wastes and hazardous recyclable materials, cross-border air and water pollution, and disposal into the sea. CEPA also contains specific provisions for the regulation of activities on lands under the jurisdiction of federal agencies, as well as Indigenous lands. For example, CEPA allows the federal government to develop administrative and equivalency agreements with provincial and territorial governments, as well as with Indigenous governments that have environmental regulatory authority.

The Federal Sustainable Development Act (FSDA, 2008) requires the development, every three years, of a Federal Sustainable Development Strategy (FSDS). The FSDS represents all of government, with Departmental Sustainable Development Strategies contributing to its objectives (Chapter 3). Other federal environmental statutes include the Canadian Environmental Assessment Act, Fisheries Act and Oceans Act (Table 2.1).

Table 2.1. **Main federal environmental acts**

Products	Emissions and effluents	Conservation and natural resource management
Canadian Environmental Protection Act		
Hazardous Products Act		
Canada Consumer Product Safety Act		
Transportation of Dangerous Goods Act		
	Canadian Environmental Assessment Act	
	Canada Water Act	
	Fisheries Act	
		Species at Risk Act
		Canada Wildlife Act
		Canada National Parks Act Oceans Act
		Migratory Birds Convention Act
	Federal Sustainable Development Act	
	Environmental Enforcement Act	

Source: Country submission.

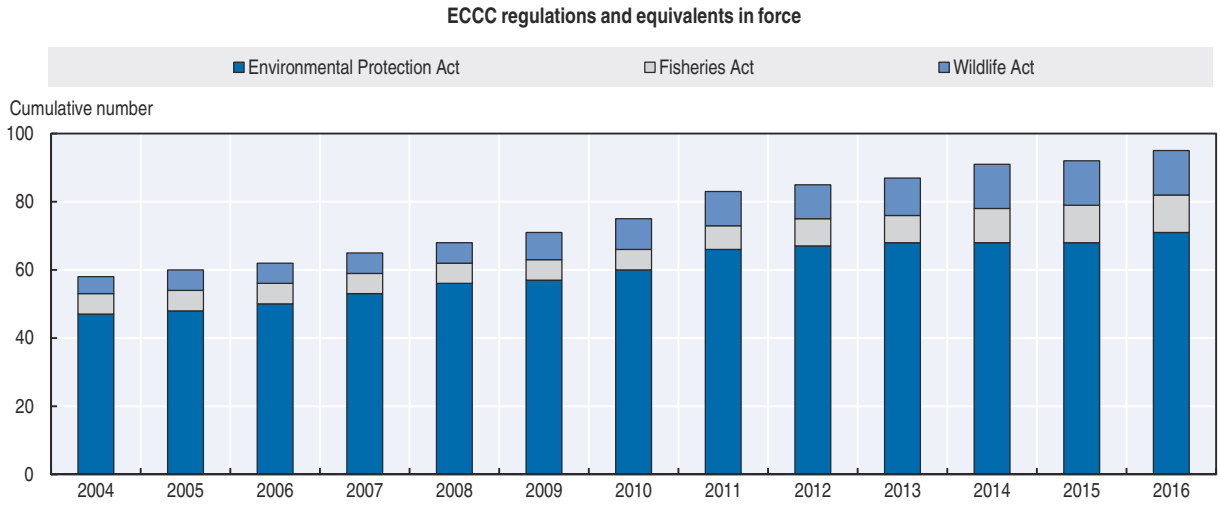
ECCC's regulatory portfolio has increased significantly since 2004 (Figure 2.1). The number of regulations under CEPA, the Fisheries Act and the Wildlife Act grew by more than 50%. This has strengthened the federal government's role in environmental regulation and, at the same time, increased its administrative burden. It is unclear whether the increase has helped to harmonise regulations across provinces and territories.

3.1. Regulatory and policy evaluation

Regulatory impact analysis

In 1999, the government of Canada mandated that regulatory impact analysis (RIA) assess the potential impacts of regulatory proposals on the environment, workers, businesses, consumers and other sectors of society. As part of RIA, cost-benefit analysis is conducted for all significant regulatory proposals on the basis of the Canadian Cost-Benefit Analysis Guide. These include all new and amended regulations under CEPA. For example, RIA was conducted in 2016 for amendments to Prohibition of Certain Toxic Substances Regulations. RIA takes into account the 2012 Cabinet Directive on Regulatory Management,

Figure 2.1. **The federal government's environmental regulatory portfolio has grown**



Note: "Equivalents" includes orders and amendments to regulations and schedules.
Source: Country submission.

StatLink http://dx.doi.org/10.1787/888933565431

which stipulated the "One-for-One" Rule (a new regulation should replace at least one old one), evaluation of impact on small businesses and other measures to monitor and control the administrative burden.

RIA may also require a performance measurement and evaluation plan for the regulatory programme, including timelines for follow-up. Its results are presented to decision makers and the public in a non-technical Regulatory Impact Analysis Statement, which is published in the Canada Gazette. Similar provisions exist at the provincial level (e.g. in Quebec).

Strategic environmental assessment

In accordance with the 2010 Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals, strategic environmental assessment (SEA) must be conducted when a proposal may result in important positive or negative environmental effects. Departments and agencies assess the importance of potential environmental effects based on considerations such as frequency and duration of the effect, location and magnitude, timing, risk (for example, to human health), irreversibility and potential for cumulative effects. However, the required coverage of SEA is ambiguous in terms of the types of documents to be assessed and the importance of potential environmental impact. The adoption of the Federal Sustainable Development Act had a direct impact on the SEA system, as FSDS goals and targets have become criteria for the examination of environmental implications of federal government policies, programmes and plans.

These steps demonstrate progress in implementing the 2004 *Environmental Performance Review* (EPR) recommendation to develop and expand the use of SEA. The Commissioner of the Environment and Sustainable Development found that the Department of Justice, Parks Canada, and Public Services and Procurement Canada applied the SEA Cabinet Directive to most of their proposals. However, overall the reviewed federal departments applied the directive to only 23% of the 243 policy, plan and programme proposals submitted for approval to Cabinet in 2013-15. Furthermore, sometimes SEA was conducted too late in the approval

process (OAG, 2016). There are few SEA requirements at the provincial level. Quebec introduced SEA for oil and gas development and transportation activities in 2014 and expects to generalise the requirements in accordance with the 2017 Environmental Quality Act.

In addition to the use of SEA, Health Canada's Climate Change and Innovation Bureau champions the importance of climate change and health vulnerability assessments conducted by public health officials at the local and regional levels. Such assessments identify opportunities to incorporate climate change information into existing policies and programmes designed to manage health risks associated with weather and climate. They also inform development of new programmes where necessary to reduce current risks to health and the severity of future impacts. For example, Ontario published the Climate Change and Health Toolkit, which includes climate change and health vulnerability and adaptation assessment guidelines for public health units in the province (MoH, 2016).

Ex post evaluation

Evaluation plays a key role in supporting the federal government's commitment to ensuring value for money in the delivery of its programmes. Tracking and reporting progress, as well as assessing the effectiveness of federal agencies' work, is a high political priority (PMO, 2017). The previous Treasury Board's Policy on Evaluation and the supporting Directive on the Evaluation Function and Standard on Evaluation for the Government of Canada were repealed in 2016. They will be replaced in 2017 with a new policy that emphasises result-oriented Departmental Plans and that would include performance information profiles.

Provincial environmental authorities have also developed performance measures as part of routine planning. For example, the Ministry of Environment of British Columbia measures environmental outcomes (GHG emissions, sound waste management practices), as well as outcomes of compliance assurance activities (MoE, 2015, 2016).

Routine programme evaluation is also conducted under the auspices of the Office of the Auditor General of Canada, whose mandate extends to the environment and sustainable development. The Commissioner of the Environment and Sustainable Development, appointed by the Auditor General, carries out this charge. Every year, the commissioner monitors and reports on how well selected federal departments and agencies have contributed to meeting the targets and goals set out in the FSDS.

3.2. Key regulatory requirements

Toxic substance control

CEPA provides the federal government with "cradle to grave" regulatory authority over toxic substances. It established a national inventory of chemical and biotechnical substances – the Domestic Substances List – and requires the assessment of "new" substances not included on this list. The act also instructs importers and manufacturers to notify the federal government of a new substance before it enters the Canadian market.

If the government determines that a substance may present a danger to human health or the environment, it may add the substance to the Toxic Substances List. Currently, the list contains over 100 toxic substances or groups of substances. Within two years of a substance being added to the list, ECCC is required to take action with respect to its management. Such actions may include preventive or control measures, such as securing voluntary agreements, requiring pollution prevention plans or issuing restrictive regulations that may provide for phasing out or outright banning of a substance.

Air quality and emission standards

As part of the Air Quality Management System (AQMS) introduced in 2012,[2] Canadian Ambient Air Quality Standards (CAAQSs) have been established for sulphur dioxide (SO_2), fine particulate matter ($PM_{2.5}$) and ozone. The CAAQSs are more stringent than the respective US National Ambient Air Quality Standards. However, they are slightly less stringent than the World Health Organization's Air Quality Guidelines. Work is underway to establish a standard for nitrogen dioxide (NO_2). Provinces and territories delineate and manage air zones within their jurisdiction to ensure air quality improvement and prevent exceedance of the standards (CCME, 2012). The federal government facilitates discussion of air quality issues in airsheds that span several jurisdictions.

While the provinces manage most air emissions, there are a number of industry-specific federal air pollution regulations. The Multi-Sector Air Pollutants Regulations adopted in 2016 became the first-ever mandatory federal air emission standards. They cover boilers, heaters and engines, as well as the cement sector, and are focused on NO_x, SO_2, volatile organic compounds and particulate matter. The regulations are based on best practice industrial emission requirements inside or outside Canada. Other federal regulations limit emissions of asbestos, lead, mercury and vinyl chloride. The provinces and territories have the right to go beyond these standards and introduce more stringent requirements. Guide values for air emissions from several other industrial sectors and equipment types have been developed as non-regulatory instruments (e.g. codes of practice for the aluminium, iron and steel sectors adopted in 2016, Section 4.4).

With respect to mobile sources, the federal government has the lead responsibility for regulating and implementing emission and fuel standards for new vehicles and engines, as well as emissions from ships, aviation and rail transport. In 2015, Canada introduced stringent air pollution emission standards for new cars and light trucks, aligned with those of the United States. However, regulating the existing vehicle fleet remains a challenge. Provinces and territories may enact further measures to reduce emissions from mobile sources, particularly with regulating the in-use fleet, but so far have not done so.

Water quality and effluent standards

The CCME has issued Canadian Environmental Quality Guidelines (EQGs). With respect to water resources, these include Guidelines for Canadian Drinking Water Quality, Recreational Water Quality Guidelines and Aesthetics, Canadian Water Quality Guidelines for the Protection of Aquatic Life, Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses and Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. They are defined as numerical concentrations or narrative statements, recommending levels that should result in negligible risk to biota and the designated water uses they support.

Although the EQGs are nationally endorsed, provincial and territorial jurisdictions may develop their own science-based criteria, guidelines, objectives and standards. For example, the Environmental Quality Guidelines for Alberta Surface Waters (2014) have several functions. They are used to design site-specific water quality objectives, to evaluate and report on the condition of surface water quality throughout the province, and to develop water quality-based approval limits for wastewater discharges.

The Water Quality-based Effluent Limits Procedures Manual provides guidance on setting effluent limit values for point-source discharges so that they do not exceed water

quality standards in receiving water bodies. Provinces such as Alberta increasingly use total load management to improve surface water quality – an approach successfully used by Korea since 2004 (OECD, 2017a). Federal Wastewater Systems Effluent Regulations, in effect since 2015, establish specific effluent quality standards for wastewater treatment plants (Chapter 5).

Hazardous waste regulations

A number of regulations under CEPA address the movement of hazardous waste and hazardous recyclable material in, out of and across the country. Notification requirements include information on the nature and quantity of the waste or material involved; addresses and sites of exporters, importers and carriers; the proposed disposal or recycling operations; proof of written contracts between the exporters and importers; and insurance coverage. With this information, ECCC can determine whether the proposed shipment complies with regulations for the protection of human health and the environment. There is a tracking system, based on a prescribed waste manifest, for the movement of hazardous waste and hazardous recyclable material between provinces and territories, in line with best international practices. Waste disposal and movement within provincial and territorial boundaries is regulated by the respective governments.

3.3. Environmental assessment

The responsibility for federal environmental assessment (EA) rests with the Canadian Nuclear Safety Commission for nuclear power projects; the National Energy Board (NEB) for projects it regulates, such as international and interprovincial pipelines and transmission lines, and offshore oil and gas; and the CEAA for all other designated projects. Under the Canadian Environmental Assessment Act (2012), there are two types of assessment: an EA can be conducted either by the responsible authority or, for projects with greater potential for significant environmental effects or subject of public concerns, by a review panel (a group of independent experts).

An EA decision statement is issued at the end of the process with due public participation (Section 5.1). It includes the determination of whether the project is likely to cause significant adverse environmental effects and sets out conditions with respect to mitigation measures and a follow-up programme that the project proponent must comply with. The CEAA enforces these conditions in collaboration with provincial and territorial EA authorities.

Overall, the Canadian Environmental Assessment Act has resulted in a dramatic reduction in the number of projects subject to formal EA at the federal level. Many projects were either judged not to have a significant environmental impact to merit an EA or were deemed appropriate to be assessed by sub-national jurisdictions (OAG, 2014). The 2012 amendments to the National Energy Board Act introduced a standing test for public participation and limited the assessment procedure to 15 months. These changes made the EA process for energy projects less transparent. For example, the Trans Mountain Pipeline Expansion Project assessed under the new rules provoked significant public opposition: its approval in 2016 is being challenged by several First Nations, as well as Vancouver and Burnaby municipalities.

In 2016, the Minister of Environment and Climate Change established an expert panel to review federal environmental assessment processes. The review sought to restore public confidence in the credibility of EA and enhance the role of Indigenous peoples in it. In its

March 2017 report, the panel recommended the creation of a single authority in charge of all federal-level EA (the panel suggested changing the name of EA to "impact assessment"). It also detailed specific measures to strengthen co-operation among jurisdictions, integrate Indigenous considerations into decision making and ensure meaningful public participation (Box 2.1).

As part of the review of the NEB's structure, role and mandate initiated by Natural Resources Canada (NEB, 2017), environmental groups also support transferring the federal EA functions of the NEB and the Canadian Nuclear Safety Commission to a reformed federal EA body (Flanagan et al., 2017). However, the NEB review panel recommended replacing the NEB with a Canadian Energy Transmission Commission and creating a joint hearing panel between this new commission and the CEAA for environmental assessment and licensing of all major energy projects.

Box 2.1. **The federal government's expert panel recommends changes to the environmental assessment process**

The Minister of Environment and Climate Change mandated an expert panel to review federal environmental assessment (EA) processes. The panel suggested referring to EA as "impact assessment" to signify the vision of moving beyond the effects on bio-physical environment. It offered a range of recommendations on co-operation between the federal and provincial/territorial governments, integration of Indigenous considerations, public participation and use of scientific evidence. Among other measures, the panel recommended that:

- EA occur early in project development before design elements are finalised
- criteria and methodology be established to account for climate change impacts within the scope of EA
- a single authority conduct and decide upon EAs on behalf of the federal government
- substitution of the federal EA process by its provincial equivalent be available on the condition that the highest standard would apply
- Indigenous peoples be included in decision making at all stages of EA, and a funding programme be developed to provide long-term EA capacity building that responds to specific needs of diverse Indigenous groups
- the participant funding programme for EA be commensurate with the costs associated with meaningful participation in all phases of EA, including monitoring and follow-up
- EA decision statements use outcome-based conditions that set clear and specific standards of performance.

In addition, the panel suggested a tiered approach to EA, whereby regional and strategic impact assessments complement project EA. Regional assessments would address cumulative impacts within an airshed, watershed or other area on federal lands or in marine areas. Strategic assessments proposed by the panel (not to be confused with SEA) would look at implications of existing federal plans, programmes and policies for project or regional EAs.

Source: Expert Panel (2017).

All provinces have EA processes required by provincial legislation. In the territories, the EA process is governed by federal statutes (e.g. the Yukon Environmental and Socio-Economic Assessment Act, the Nunavut Planning and Project Assessment Act). Each province and territory also maintains its own regulatory regime for approving energy-related

projects (provincial pipelines, wells, etc.). In provinces such as Alberta, British Columbia and Ontario, an energy regulator conducts EA similar to the federal level. In provinces such as Quebec, EA is performed by an environmental assessment authority along with activities in other sectors. Co-operative agreements between the federal and provincial or territorial governments (Section 2.2) are intended to minimise duplication of EA efforts. For example, British Columbia and the federal government have agreed to substitute the provincial regulatory process for the federal process for several major projects that trigger both federal and provincial environmental assessment reviews (EAO, 2016).

3.4. Permitting

Environmental permitting at the federal level is based on individual statutes. For example, ECCC issues permits governing the disposal of substances at sea, activities in protected areas, import and export of hazardous wastes, and hunting of migratory birds.

Many provinces have introduced integrated environmental permits. For example, British Columbia has waste discharge authorisations under the Environmental Management Act, which defines "waste" to include air contaminants, litter, effluent and refuse, as well as biomedical and hazardous waste. Quebec is introducing environmental authorisations that cover all environmental impacts as part of a major revision of its Law on Environmental Quality. Ontario's Environmental Compliance Approval covers emissions and discharges related to air, noise, waste or wastewater. However, Alberta and Saskatchewan have separate permits and approvals under different issue-specific regulations.

Where integrated permitting exists, the integration is mostly procedural. It does not provide for holistic management of environmental impacts through application of best available techniques (BAT). Cumulative effects are seldom taken into account in setting permit conditions. Furthermore, environmental permitting in many provinces is not linked to EA; Quebec's effort to integrate the two instruments for high-risk economic activities is a notable exception. Conditions set in permits and EA decisions are enforced separately. This potentially leads to duplication of compliance assurance efforts.

A number of provinces have introduced diversification of regulatory regimes based on relative risk of regulated activities. In Ontario, for example, low-risk facilities are not required to have a permit. They can simply declare conformity to general environmental requirements. A similar arrangement is being put in place in Quebec in the framework of its environmental permitting reform. Further expanding the use of sector-based standardised requirements (general binding rules) would help reduce the administrative burden both on regulators and the regulated community, particularly small and medium-sized enterprises.

3.5. Land-use planning

About 89% of Canada's land area is public "Crown land": 41% is federal Crown land and 48% is provincial Crown land. The remaining 11% is privately owned. Only 4% of land in the provinces is federally controlled, largely as national parks, First Nations reserves or military bases. Indigenous peoples own, control or have access to over 65 million hectares (ha) of land. This represents approximately 6.5% of Canada's land mass, not including traditional territories.

Most federal Crown land is in the Northwest Territories, Nunavut and Yukon. Devolution of powers from the federal government to the territorial governments and land claim agreements have substantially changed the administration of land and natural resources

and land ownership in the Canadian Arctic. Resource administration is shared between the federal government represented by Indigenous and Northern Affairs Canada (INAC), territorial governments (except for Nunavut) and Indigenous organisations. Their mandates address defined aspects of decision making regarding impact review, impact assessment, land-use planning and use, water use, wildlife management and surface rights (INAC, 2008).

Land-use planning is under the jurisdiction of provinces and territories, all of which have their own land-use planning systems. Although they are broadly comparable, important differences exist. Provinces and territories with few inhabitants tend to centralise land-use planning. In contrast, provinces with a large number of inhabitants tend to delegate more power to local governments. This is partly due to a different legislative framework: land-use planning in the territories is embedded in northern land claims agreements, which favours centralisation. Another factor is differences in administrative capacity at the local level, reflecting the varying population sizes and resources available in the provinces. For example, in Ontario, public authorities and consulting firms employ some 4 300 professional planners; the corresponding figure for Prince Edward Island is 10-15 professional planners (OECD, 2017b).

Each province or territory has at least one regional land-use plan. Typically, regional plans contain high-level objectives and policies for growth management, environmental protection, regional-scale infrastructure and economic development. For example, Alberta's Land-use Framework for regional planning is a comprehensive strategy to better manage public and private lands and natural resources. It uses a cumulative effects approach to achieve long-term economic, environmental and social goals (Box 2.2).

Formally, municipalities in all provinces have similar powers. They can prepare and adopt different types of land-use plans as by-laws and use them to regulate development on their territory. Community plans – the main instruments for stakeholder engagement in land-use planning – are prepared for the entire administrative territory of a municipality. District plans cover specific parts of cities and towns and provide more detail than community plans. They are used to guide new developments or the redevelopment of existing neighbourhoods, but may also be created for special-purpose areas such as downtowns, educational nodes, recreational land or significant parts of the transport network. Municipalities issue planning permissions and building permits. However, their institutional capacity largely determines how these powers are exercised. Local land-use plans have historically well accounted for natural heritage and biodiversity considerations and are starting to integrate climate change adaptation concerns. However, they are weaker in incorporating other environmental concerns such as impact of transport and urban sprawl. Local plans must follow the provincial government's general policy directions, but are not subject to SEA. A legal requirement to conduct SEA of land-use plans would help make this process more systematic and comprehensive. It would also help better evaluate and address cumulative environmental effects of different activities.

Indigenous peoples' rights are a major issue in land use. Land and environmental management issues vary according to the level of their legal jurisdiction and administrative control over that land. The greatest authority is exercised under modern treaties. Indigenous communities insist on the concept of "free prior and informed consent" (FPIC) – the right to give or withhold consent to proposed projects that may affect the lands they customarily own, occupy or otherwise use. The principle of FPIC is most clearly stated in the UNDRIP (2007). In a 2014 landmark decision (SCC 44), the Supreme Court of Canada established

Box 2.2. **Alberta land-use planning takes account of cumulative environmental effects**

Alberta has seven regions, delineated along watershed boundaries. Under the Alberta Land Stewardship Act (2009) and the Alberta Land-use Framework, each region is subject to a separate regional plan based on its particular environmental, economic and social needs. A cumulative effects approach is used to manage the combined impacts of existing and new activities within the region. The types of cumulative effects considered include, among others, water withdrawals, air emissions, land-based environmental impacts and overall habitat degradation. Development decisions are considered holistically in light of the overall impacts on a region. Environmental management frameworks for different domains (e.g. air quality, water quality, biodiversity) include impact indicators and thresholds and respective monitoring, modelling and reporting arrangements.

Regional plans are binding and may be viewed as top-down policy directives governing the interpretation and implementation of all legislation in Alberta, including statutes whose primary focus is not the environment. They are developed through extensive consultations led by the Land Use Secretariat with the involvement of Indigenous communities and approved by cabinet, forming part of the government's policy for the region. Local land-use plans must be aligned with the regional ones.

The process of developing regional plans has been slow. As of early 2017, regional plans have been adopted only for two regions: Lower Athabasca in 2012 (the plan has since been reopened to address concerns by Indigenous communities) and South Saskatchewan in 2014. In three regions, the planning process has not even started. SEA was piloted in the development of the Lower Athabasca regional plan. However, it has not been institutionalised as part of land-use planning across the province.

Source: Alberta Environment and Parks (2016).

Aboriginal land title for the Tsilhqot'in First Nation in British Columbia. As a result of this decision, provinces cannot claim a right to engage in clear-cut logging on lands protected by Aboriginal title; they must gain approval for such action from the title holder before proceeding. However, despite Canada's recent adherence to the UNDRIP, it has not yet established a formal process to implement FPIC.

Indigenous communities sometimes engage in land-use planning. However, unlike regular community plans, plans in Indigenous communities have no legal status. As a result, they do not give Indigenous peoples grounds to oppose natural resource development projects on their land. This contradicts FPIC and often leads to conflicts. The federal and provincial governments encourage development companies to negotiate so-called impact-benefit agreements with Indigenous peoples to settle financial compensation, provision of jobs and eventual environmental restoration (Quebec, for example, has developed guidelines on such agreements). However, companies are under no obligation to do so, the government is not a party to the agreements, and the agreements seldom result in changes to the project itself. Typically, most such agreements require that Indigenous peoples either support the project or refrain from opposing it in environmental assessment or judicial proceedings.

4. Compliance assurance

Compliance assurance covers the promotion, monitoring and enforcement of compliance, as well as liability for environmental damage. In Canada, federal, provincial and territorial authorities undertake compliance assurance under their respective legislation.

Canadian municipalities have environmental enforcement powers with respect to their bylaws (e.g. on sewerage and solid waste management).

4.1. *Environmental inspections*

ECCC conducts most of its inspections and investigations (in case of suspected violations) under CEPA. The compliance monitoring programme is made up of priority and risk-based targeted inspections (about 40%) and random checks (20%), with the rest conducted in response to accidents and complaints. Factors that influence the identification of priority regulations for compliance monitoring include the nature of regulatory provisions, operational complexity and capacity, and domestic and international commitments. In addition, new regulations brought into effect are identified as priorities within ECCC's inspection programme. The schedule of inspections is determined by the risk that the regulated substance or activity presents to the environment or human health, and by the compliance record of the regulated entity. ECCC launched a new national enforcement case management system in February 2017. It also expanded its software-supported analytical capabilities in the field of compliance assurance.

Several provincial authorities also use risk-based targeting of environmental inspections. In British Columbia, for example, the Ministry of Environment's inspection policy dictates the frequency of inspections for high-, medium- and low-risk sites. Newly regulated sectors or segments of the regulated community where non-compliance trends have been detected may be inspected more frequently. Almost three-quarters of inspections are proactive, which is quite high by international standards, while the rest respond to incidents or complaints (MoE, 2016).

British Columbia also demonstrates good practice with regard to interagency collaboration in compliance monitoring. Its Ministry of Environment co-ordinates its inspections with the Ministry of Energy and Mines; Ministry of Forests, Lands and Natural Resource Operations; Department of Fisheries and Oceans; provincial work safety and health authorities; and ECCC and local governments. Officers from all these agencies provide environment ministry inspectors with information about activities they observe as part of their respective duties, and vice versa (MoE, 2016).

4.2. *Enforcement tools*

Criminal sanctions

Canada has traditionally relied on criminal penalties for environmental enforcement. Most laws impose sanctions on company officers who authorise or accept an offence, whether or not the company itself is prosecuted. Maximum fines are doubled for subsequent offences and can be levied for each day an offence continues. When imposing penalties, courts are required to consider specified aggravating factors to ensure that penalties reflect the gravity of the offence.[3] These penalties do not yet account for the economic benefit of non-compliance. However, ECCC has been exploring ways to use the experience of the US Environmental Protection Agency, which has been demonstrating good practice in this area for over 30 years.

The Environmental Enforcement Act (EEA, 2010) introduced a new fine regime to be applied by courts following a conviction under nine federal environmental statutes. Under the new regime, designated offences involving direct harm or risk of harm to the environment, or obstruction of authority, are subject to minimum fines and an increased

range of fines for a first offence: from CAD 100 000 to CAD 6 million for corporations. Other offences carry a maximum fine of CAD 500 000 (ECCC, 2016a). The EEA also authorises suspension or revocation of the offender's licences or permits upon conviction of an environmental crime.

Enforcement data gathered under different federal environmental laws are often inconsistent, incomplete and hard to access. Limited information identifying environmental offenders, incident location and the exact nature of the violation is disclosed to the public (Amos et al., 2011).

Environmental Protection Alternative Measures (EPAMs) offer an alternative to court prosecution for a violation of CEPA. An agreement, negotiated with the accused by the Department of Justice in consultation with ECCC, specifies measures the violator must take to restore compliance. These measures could include clean-up of environmental damage or pollution prevention and control. Once conditions of the EPAM agreement are met, the charges are dropped.

Administrative sanctions

The federal Environmental Violations Administrative Monetary Penalties Act (2009) authorised administrative monetary penalties. These provide an alternative to other enforcement measures, such as written warnings and prosecution, which may not always be effective or appropriate. The administrative fines may be up to CAD 5 000 for individuals and up to CAD 25 000 for legal entities. Similarly, Quebec and British Columbia introduced administrative monetary penalties for moderate offences (e.g. failure to submit a report or minor non-compliance with permit conditions) in 2011 and 2014, respectively. In Quebec, these fines range up to CAD 2 000 for physical persons and up to CAD 10 000 for legal entities. British Columbia's administrative monetary penalties in the natural resource sector range from CAD 2 000 to CAD 100 000 depending on the gravity of the violation. This good practice merits replication in other provinces and territories.

Management of enforcement activities

Different Canadian jurisdictions have introduced good practices with respect to enforcement policies, disclosure of enforcement records and measurement of enforcement outcomes. For example, both environmental enforcement authorities in British Columbia have produced guidance on the application of different enforcement measures (Box 2.3).

At the same time, there is evidence of "regulatory capture" in enforcement against powerful industries. A recent report by British Columbia's Auditor General concluded that neither the Ministry of Environment nor the Ministry of Energy and Mines conducts effective compliance monitoring and enforcement in the province's mining sector. In many cases, operators who violate the law are given repeated warnings and opportunities to return to compliance, but never face real sanctions, even for clear and dangerous violations. Furthermore, neither ministry has adequately evaluated the effectiveness of its compliance assurance efforts (BC Auditor General, 2016).

The federal EEA requires a publicly disclosed registry of corporations convicted under certain environmental and wildlife laws. The registry contains convictions of corporate offenders obtained over the past five years under environmental legislation enforced by ECCC and Parks Canada. Public disclosure of enforcement information is also widely practised at the provincial level. In British Columbia, the Ministry of Environment and the

Box 2.3. **British Columbia provides guidance on proportionate enforcement decisions**

The Environmental Assessment Office of British Columbia monitors compliance with legally binding conditions of environmental assessment certificates. It has developed a risk-based tool for assessing the factors that can influence the selection of enforcement measures – the Enforcement Decision Matrix. The matrix is intended to be a guidance tool used by compliance officers at their discretion when considering the context and specifics of individual cases of non-compliance.

On one axis, the matrix ranks the nature of non-compliance (minor, moderate or major) depending on the actual or potential harm from the violation. On the other, it measures the likelihood of achieving compliance (high, moderate or low). The probability that the operator will respond appropriately to the enforcement action depends on several factors. These include technical challenges in restoring compliance, the operator's compliance history, voluntary disclosure of the violation, and the presence of wilful or negligent non-compliant behaviour. Based on these factors, the enforcement officer would choose from a menu of enforcement tools (from a warning to a compliance agreement, a minister's compliance order or prosecution).

Among its activities, British Columbia's Ministry of Environment conducts compliance monitoring under the provincial Environmental Management Act. It uses a similar tool (Non-Compliance Decision Matrix), which takes into account the same factors, but with five categories for both the likelihood of compliance and the extent of actual or potential harm.

Source: EAO (2015b); MoE (2014).

Ministry of Forests, Lands and Natural Resource Operations jointly publish quarterly Environmental Enforcement Summaries. These list all cases of enforcement actions (orders, administrative penalties and court convictions) against companies and individuals. They also maintain an Environmental Violations Database.

Over the last decade, federal and provincial authorities have tried to develop outcome indicators of environmental enforcement and attribute results to individual instruments (Box 2.4). So far, these efforts have been inconclusive. However, they do show the increased focus on performance management of compliance assurance and should be pursued, based on the still limited but growing international experience in this area (Mazur, 2010).

Box 2.4. **Measuring enforcement outcomes: A challenge**

ECCC introduced an Environmental Enforcement Improvement Index in 2010. The index was intended to measure the mass of regulated substances reduced through enforcement actions, in equivalent metric tonnes of reduced substance. It was expected to gradually integrate the releases of over 40 air and water pollutants weighted in accordance with their toxicological impact (using the inverse values of respective ambient environmental quality standards as coefficients). Specific coefficients were also set for global-impact pollutants (such as greenhouse gases and ozone-depleting substances) that do not have toxicity-related standards.

Essentially, the initiative was designed to first account for reductions of individual regulated pollutants as a result of compliance assurance activities and then tried to aggregate these reductions into a composite measure of their environmental impact. Data

Box 2.4. **Measuring enforcement outcomes: A challenge** *(cont.)*

had to be obtained during enforcement activities and recorded in the ECCC enforcement database. However, ECCC found it difficult to argue convincingly for a causal link between enforcement activities and environmental outcomes. This was particularly the case in trying to make a claim about preventing potential or real environmental harm via some enforcement action. Overall, this complex approach proved excessively costly and was abandoned shortly after its introduction.

Since 2010, ECCC has conducted a pilot project to measure rates of dry cleaners' compliance with toxic substances regulations in order to establish a compliance baseline and assess the value of inspections. It has also carried out a Targeted Outcome Project on compliance with regulations for underground storage tanks for petroleum products (EC, 2015). However, these efforts remain sporadic.

British Columbia's Ministry of Environment uses binary compliance rates (the share of facilities being in or out of compliance). The Ontario Ministry of the Environment and Climate Change attempted to introduce more comprehensive compliance rates in 2008. Its compliance index was a weighted sum of violations of legislative provisions and permit ("certificate of approval") conditions by individual facilities. It assigned individual weights to approximately 1 300 legislative provisions. Each violation was to be classified as one of four "contravention categories" (reporting and recordkeeping, operating standards, monitoring and sampling, or exceedance of emission/discharge limits) and assigned a corresponding weight. These weights would distinguish between procedural and substantive non-compliance. In this way, they would reflect to some extent the level of potential environmental impact from the offence (higher weights represent a larger impact). However, the compliance index has not been implemented. This is due both to its complexity and the need for an expensive random sample approach to inspection planning to collect supporting data.

Source: IEC (2010); EC (2015); Mazur (2010); MoE (2016).

4.3. *Environmental liability*

Liability for damage to the environment

Canada has several strong environmental liability regimes under federal and provincial law. Physical and legal entities are liable for causing an adverse effect on the environment, including plants and animals, or for causing nuisance, loss of enjoyment or harm to human health or safety. For example, all Canadian environmental regulators can require a polluter to clean up water pollution, typically through some form of administrative order. The Supreme Court of Canada endorsed the principle of monetary compensation to the public for harm to environmental resources in British Columbia v. Canadian Forest Products Ltd. (2004). Many provinces have statutory rights for the government to recover costs from polluters for cleaning up and restoring the environment. In Ontario, even municipalities have a right to order a polluter to pay costs incurred in responding to a release of harmful substances (Willms and Shier, 2007).

Liability provisions with respect to remediating past pollution are generally applied to contaminated land, but not to damage to water bodies and ecosystems. Under provincial environmental laws, liability for clean-up of contaminated land is typically imposed on current and previous owners and occupiers. In some cases, liability may be imposed upon producers of the substances that cause the contamination.

In most provinces, liability is strict, which means operating within permit limits is not a defence against financial responsibility for the clean-up. However, some court decisions have taken compliance into account. Most relevant legal provisions impose joint and several liability on all potentially liable parties. This means that damages may be recovered from any of the defendants regardless of their individual share of the liability. However, civil courts typically apportion liability based on fault when there are multiple liable parties (Tidball et al., 2016).

Federal and provincial governments require the use of financial assurance instruments in several sectors, including mining and energy, to avoid spending taxpayer money on clean-up and remediation. For example, Alberta's Licensee Liability Rating programme ensures that companies have adequate assets to deal with abandonment, remediation and reclamation of their liabilities (AER, 2014). Absolute liability limits are also used in certain sectors to limit or cap the total amount that an operator may be liable for if an incident occurs, without proof of fault. Assurance can be provided in the form of letters of credit, trust funds, guarantees and insurance coverage.

Environmental risks are most commonly covered by insurance, and Canadian insurers offer several environmental insurance products. Pollution legal liability coverage, which generally applies to new pollution but may cover unknown pre-existing conditions, is relatively easy to obtain. Cost cap insurance for environmental remediation projects is more expensive and more difficult to get. The cost of environmental insurance premiums may be prohibitive. Typically, it includes the cost incurred by the insurer to retain an environmental consultant to investigate the risk (Tidball et al., 2016). However, such risk assessment serves as an incentive for operators to reduce their risk by engaging in pollution prevention activities.

Contaminated sites

The management of past contamination is primarily the responsibility of sub-national governments. The circumstances under which a regulator can require investigation and remediation of contaminated land vary from jurisdiction to jurisdiction. Several provinces have specific regulatory regimes for the assessment and remediation of contaminated sites. Some, such as Ontario, maintain a special fund to pay for the clean-up of contaminated land where no financially solvent liable party can be identified. Alberta, which has tens of thousands of ownerless abandoned oil wells, established an Orphaned Well Clean-up Fund with revenues from levies imposed on existing well operators. The levy amount is based on the estimated cost of reclamation activities for the upcoming fiscal year. Similarly, it created a Tailings Management Fund of CAD 500 million (funded by current operators) to address environmental problems (including groundwater contamination) of historic oil sands tailings.

Ontario's Ministry of the Environment and Climate Change can issue orders requiring remediation of land contaminated by current or past activities. Some orders require a comprehensive remediation plan, involving expensive studies before implementation of remediation measures. In Quebec, the Environmental Quality Act contains a framework for managing contaminated sites. If a site assessment indicates that the soil or groundwater quality standards are exceeded, the operator is required to provide the Ministry of Sustainable Development, Environment and Climate Change (MSDCC) with a remediation plan and execution timetable for approval. Once the remediation plan is approved by the MSDCC, it must be carried out, and a remediation report prepared and certified by a MSDCC-recognised expert (Blakes, 2012). Other provinces have similar arrangements.

The federal government maintains a public inventory of contaminated sites for which it is responsible. The 2005 Federal Contaminated Sites Action Plan allocated more than CAD 4.5 billion to assess and remediate federal contaminated sites. On federal lands in the territories, INAC manages abandoned contaminated sites through the Northern Contaminated Sites Program. These sites were contaminated by private sector mining, oil and gas activities, as well as by government military activity that occurred over half a century ago. This federal programme aims to reduce and eliminate, where possible, risks to human and environmental health, giving priority to sites posing the highest risk. According to changes in accounting rules in 2015, governments must include remediation costs for contaminated properties they own on their balance sheets. This represents an incentive for both the federal and provincial governments to accelerate the clean-up of contaminated sites.

4.4. Promotion of compliance and green practices

Government promotion of compliance and green practices can reduce costs for businesses by allowing them to achieve and maintain compliance as efficiently as possible. It may also reduce regulatory costs by increasing the efficiency of compliance monitoring and enforcement. Providing advice and guidance is particularly effective when targeted at SMEs (defined in Canada as having fewer than 500 employees). Federal and provincial environmental authorities increasingly recognise the importance of compliance promotion. They also use voluntary agreements and green public procurement to advance the adoption of green business practices.

Compliance promotion

Federal compliance promotion efforts focus on geographically dispersed and hard to reach SMEs, Indigenous communities and federal agencies. In 2014-15, ECCC worked on compliance strategies and compliance promotion plans for 24 different subject areas. It uses multiple outreach tools, including workshops, information sessions, information package e-mails and mail-outs, as well as Twitter and web banner advertising. Many of these activities are carried out in collaboration with provincial and territorial governments, as well as with non-governmental organisations (NGOs).

At the provincial level, the Ministry of Environment of British Columbia recently issued technical guidance for sound environmental practices in the mining sector, as well as promotional materials in the concrete, agricultural and hazardous waste management sectors. These were accompanied by workshops for sector representatives (MoE, 2016). Provincial authorities published numerous guidance documents online to guide project proponents through the environmental assessment process.

Voluntary agreements and codes of practice

In line with the 2004 EPR recommendation to continue to develop cost-effective voluntary approaches with industry, ECCC uses performance agreements that commit participating sectors or companies to specific measures or performance levels. Performance agreements are voluntary, non-statutory instruments that allow parties with common objectives to address a particular environmental issue. Performance agreements typically set quantitative objectives such as a maximum limit on the release of a substance, but may also include qualitative targets such as implementing activities within a code of practice, or restricting the sale or availability of a product by a certain date. Every agreement requires verification of results through audits, inspections, interviews or other means.

Since the adoption of the federal Policy Framework for Environmental Performance Agreements in 2001, ECCC has signed 14 such agreements with different industries, including chemicals, transportation, metal processing, consumer products, forestry and printing. In addition to industry associations, signatories have included three federal departments (Health Canada, Industry Canada and Transport Canada) and two provincial governments (Ontario and Alberta). Eleven agreements have been completed (with objectives achieved by most of them[4]), and three are still in effect (Box 2.5). Most agreements have had objectives related to improving air quality (ECCC, 2017). Transport Canada also manages voluntary agreements with industry. These include an action plan to reduce GHGs from aviation and an agreement with the Railway Association of Canada to report emissions of GHGs and other key air pollutants.

Box 2.5. **Environmental performance agreements aim to minimise release of harmful substances**

Vinyl industry (2015-20): This agreement, signed by ECCC, the Vinyl Institute of Canada and participating companies, seeks the full implementation of the Guideline for the Environmental Management of Tin Stabilizers in Canada by all vinyl compounding facilities to prevent the release of toxic tin stabilizers into the environment.

Refractory ceramic fibre industry (2013-18): This agreement between ECCC and five companies from the refractory ceramic fibre (RCF) industry maintains the maximum allowable concentration limits established in previous agreements for RCF in ambient air and maintains reporting requirements for RCF. It promotes inspection and maintenance of pollution control equipment and confirms the commitment of the RCF industry to maintain the existing Product Stewardship Program.

Paper recycling companies (2013-17): This agreement between ECCC and 13 paper recycling companies was designed to initiate action by paper recycling mills to minimise the risk of environmental impacts from effluent releases of Bisphenol A (BPA) to the greatest extent practicable. BPA, used as a colour developer and in certain varieties of ink, is present as a contaminant in recycled paper. It may be released in effluents by some paper recycling mills.

Source: ECCC (2017).

Under CEPA, the federal Minister of Environment and Climate Change or the Minister of Health can issue codes of practice. These can be either the sole risk management instrument or part of a mix of instruments to address pollution by one or several toxic substances from certain activity sectors. They are typically used when it is difficult to establish numerical restrictions and when the regulated community is receptive to implementing a code of practice (ECCC, 2016b). Recent codes of practice have targeted reductions in the following areas: residential wood burning appliances (2012), emissions of fine particulate matter ($PM_{2.5}$) from the aluminium sector (May 2016), fugitive emissions of total particulate matter and volatile organic compounds from the iron, steel and ilmenite sector (May 2016) and from end-of-life lamps containing mercury (February 2017).

Greening public procurement and eco-labelling

The federal and most provincial governments actively use public procurement to support green business practices. The federal government established a Policy on Green Procurement in 2006. Further, the 2016-19 FSDS includes a target to "promote public

procurement practices that are sustainable, in accordance with national policies and priorities". As a result, all 26 departments bound by the Federal Sustainable Development Act consider environmental performance in their procurement decisions. Green procurement plans for federal agencies have been established for over 30 goods and services categories, including information technology and audio-visual equipment, vehicles, office furniture, printers and paper, and business travel. Green scorecards identify environmental considerations in procurement decisions for each product or service, as well as future plans for incorporating environmental criteria in federal government purchases. The provinces have similar practices (Box 2.6).

Box 2.6. **Provincial governments use public procurement to promote green business practices**

British Columbia Guidelines for Procurement of Environmentally Responsible Products and Services are designed to encourage ministries to consider environmentally responsible products and services as part of their purchasing decisions. They mandate a life cycle approach to setting evaluation criteria in procurement solicitation documents. To that end, they focus on the environmental impact of production processes, energy use, and maintenance and disposal requirements.

The province of Newfoundland and Labrador developed a Guide for Purchasing Environmentally Preferable Products in collaboration between the Government Purchasing Agency and the Office of Climate Change and Energy Efficiency. It contains fact sheets for 15 green product categories, as well as on greening of procurement of buildings. Albeit nonbinding, the guide provides recommendations on integrating environmental considerations into institutional processes related to public procurement. These are accompanied by worksheets on selecting green issues for the tender, defining green procurement terms, using green labelling, reporting, etc.

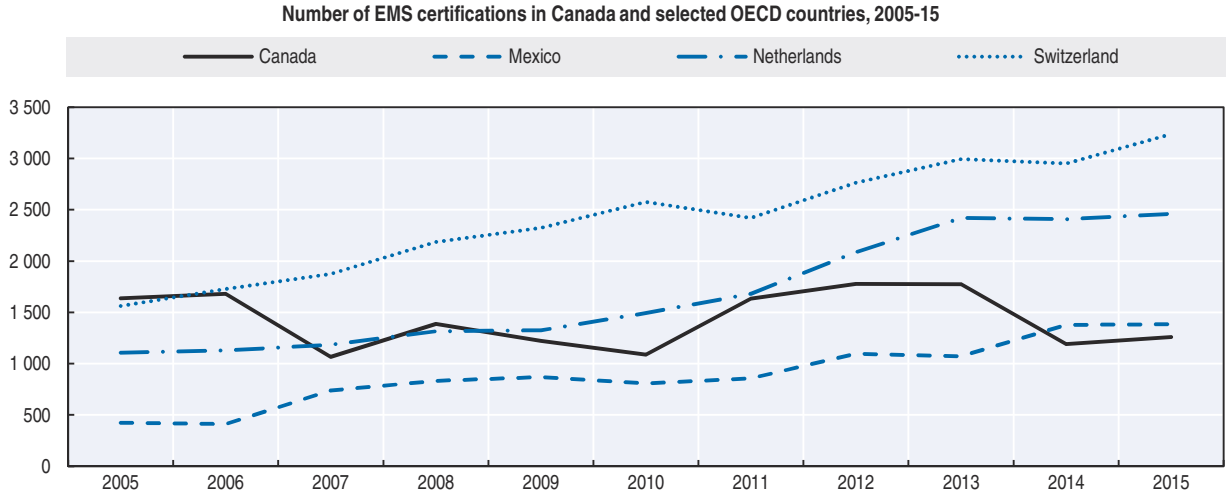
Source: Government of Newfoundland and Labrador (2014); Government of British Columbia (2016).

Green public procurement criteria often require purchasing of eco-labelled products. Canada uses 113 national, provincial and international eco-labels (Ecolabel Index, 2017), including the EnerGuide for appliances (Chapter 4). Eco-labelling programmes are administered by government bodies or private sector labelling standards institutions and typically involve certification by independent third-party organisations.

Environmental management system certifications and awards

The number of new certifications to the ISO 14001 environmental management system (EMS) standard in Canada has been declining in recent years. This goes against the trend in almost every other OECD member country. The 1 260 new certifications in 2015 is lower than in 2005. The figure is roughly on par with Mexico's almost 1 400, but much lower than in many European countries (Figure 2.2). This decline is likely caused by lack of market demand for EMS certification; it is not a criterion of green public procurement. However, the absence of regulatory or economic incentives (such as lower inspection frequency or reduced permit fees) from the government may also play a role in the decline. In addition, many smaller businesses establish an EMS, but are not willing to pay the high cost associated with third-party certification.

Figure 2.2. **The number of new EMS certifications is declining**



Source: ISO (2016), *ISO Survey 2015.*

StatLink http://dx.doi.org/10.1787/888933565450

Governments can use positive public relations incentives to promote environmentally friendly business behaviour. While Canadian environmental regulators underuse this potential, the business community has established a number of environmental awards. For example, the Globe Foundation, a Vancouver-based not-for-profit private business foundation, promotes the business case for sustainable development. Among other actions, it offers Globe Awards for Environmental Excellence in five different categories. These awards recognise achievements in corporate environmental stewardship, technology innovation and leadership by improving environmental performance beyond regulatory compliance (Globe, 2016).

5. Promoting environmental democracy

Canada ranked 35th in the world on the Environmental Democracy Index (EDI). Its combined score on access to information, public participation and access to justice was just above the world average.[5] Canada scored well on the justice pillar, but with lower scores on transparency and participation. The EDI assessment emphasised that broadening federal legal protections for public rights to participate in environmental decision making and lowering financial barriers to justice would enhance support to environmental democracy (WRI, 2016).

5.1. *Public participation in environmental decision making*

Public consultation and transparency are prominent features of Canadian government decision making. Ontario's Environmental Bill of Rights (1993) and equivalent laws in several other provinces give citizens the right to participate in environmental decision making. Indigenous peoples, stakeholders and the public are consulted before federal or provincial statutes or regulations are passed. Some federal and provincial statutes require pre-posting or consultation for permits or approvals for air emissions, water and wastewater discharges, and waste management and disposal. However, these laws do not require government agencies to account for public comments on environmental decisions (WRI, 2016).

The Pan-Canadian Framework on Clean Growth and Climate Change is the most recent example of broad collaboration and engagement of civil society at different levels. The process has taken the form of working groups involving Indigenous organisations and peoples, and multiple stakeholders, as well as town hall meetings, an interactive website, etc. More than 13 000 comments from the public were received over five months.

Public participation is also a particularly important element of the EA process at the federal and provincial/territorial levels. It is ensured through notification, reasonable timing for public comment, and provision of accessible information and transparent reporting of results. The federal Participant Funding Process helps cover citizen groups' costs of participating in EA. In British Columbia, the environmental assessment process includes two public comment periods: on the draft application and on the accepted one. In addition, the project proponent and/or the British Columbia Environmental Assessment Office (EAO) may hold community information sessions, and substantial project information is made publicly available. The EAO recognises the need to make the information submitted to the public's review more readily accessible to a broad, non-technical audience (EAO, 2015a).

The duty to consult Indigenous groups is a key part of the federal government's activities, in accordance with the Guidelines for Federal Officials to Fulfil the Duty to Consult (2011). The government of Canada signs consultation protocols with Indigenous groups to create a process for consulting on potential adverse effects on Indigenous rights. Since 2008, INAC has supported federal departments and agencies in fulfilling the government of Canada's duty to consult by providing guidelines, training and other tools. ECCC also engages with First Nations, Inuit and Métis via five National Indigenous organisations with associated offices, as well as provincial and territorial Indigenous organisations (Chiefs of Ontario, First Nations of Quebec and Labrador, etc.).

In the environmental domain, such consultations concern policy and regulatory development, EA, licensing and permitting, etc. However, many Indigenous communities feel that the consultation process often starts when a policy or a project has already been designed. As a result, they believe it gives them too little influence over the decision. Several provinces (e.g. Alberta and Quebec) are revising policies for consultation with Indigenous peoples to take account of these concerns and move towards "co-creating" engagement approaches.

Indigenous peoples of Canada would like recognition as right-holders rather than stakeholders in the context of natural resource management and claim a special status in environmental decision making. In the Tsilhqot'in Nation v. British Columbia case (Section 3.5), the Supreme Court of Canada ruled in 2014 that the Crown in the future must obtain consent from the Indigenous community rather than just fulfil the duty to consult.

In May 2016, Canada officially removed its objector status to the UNDRIP, almost a decade after the Declaration was adopted. The federal government declared that it intends to fully implement the UNDRIP. Increasingly, Indigenous groups may provide input through expanded Indigenous consultation or general public participation. For example, the CEEA engages Indigenous groups in research, guidance (e.g. technical guidance related to current use of lands and resources for traditional purposes) and training. In 2016, it supported a joint pilot project with the BC First Nations Energy & Mining Council to involve Indigenous leaders in improving environmental assessment practice.

Indigenous peoples have met the federal government's recently enhanced outreach with careful optimism. However, multiple conflicts with respect to specific natural resource

development projects continue (Box 2.7). Indigenous communities are more routinely consulted, but their opinion is essentially sought on the impacts of specific projects, with a view to reach a compensation agreement, but not on the existence and design of those projects. Canada's adherence to the UNDRIP is an important step forward, but it needs to be followed up. An agreement should be reached between the government and Indigenous peoples on the practical definition of consultation. For example, it should define who should be consulted: discussions with community leaders may not reflect a community's opinion, putting implementation at risk. It should also define FPIC, particularly whether the right to oppose a project constitutes a veto. One area of priority practical implementation of FPIC is EA processes at the federal and provincial levels (Papillon and Rodon, 2016). Furthermore, Indigenous communities and organisations need greater capacity to take advantage of these consultation opportunities.

Box 2.7. **Indigenous peoples fight for their rights against the Site C Dam project**

The Peace River Valley in northeastern British Columbia is a unique ecosystem. It is one of the very few areas in the region that has been so far largely preserved from large-scale resource development. First Nations and Métis families and communities rely on the valley for hunting and fishing, gathering berries and sacred medicine, and holding ceremonies.

Site C is the large hydroelectric dam, worth CAD 8.8 billion, being constructed on the Peace River between Fort St. John and Hudson's Hope, BC. The dam is expected to create 5 100 gigawatt hours of energy each year, enough to power 450 000 homes. However, to create the reservoir, 83 km of river valley will be flooded. This will wipe out 5 550 ha of land, leading to a severe impact on Indigenous peoples. A joint federal-province environmental impact assessment concluded that the dam would "severely undermine" use of the land, make fishing unsafe for at least a generation, and submerge burial grounds and other crucial cultural and historical sites. The BC government approved the project in December 2014, but the West Moberly and Prophet River First Nations have gone to federal court to protect their traditional lands. Their struggle has been supported by the Union of British Columbia Indian Chiefs, the Assembly of First Nations and many others, including local farmers and other landowners in the Peace River Valley.

Source: Amnesty International (2016).

5.2. Access to environmental information

Canada has federal, provincial and municipal access to information legislation that compels disclosure of government information to the public. At the federal level, these rights are provided by the Access to Information Act. Provincial statutes include the Nova Scotia Freedom of Information and Protection of Privacy Act, as well as provincial statutes for municipalities such as Ontario's Municipal Freedom of Information and Protection of Privacy Act. Notably, Ontario's act requires municipal officials to notify the public or affected persons of a grave environmental, health or safety hazard to the public. The federal government is also implementing the 2014 Directive on Open Government, which requires federal data and information to be easily accessible and usable by the public, as the Access to Information Act process is often slow and inefficient.

The Canadian Environmental Sustainability Indicators (CESI) programme measures progress in the FSDS implementation. It provides data and information to track Canada's

performance on key environmental sustainability issues, including climate change and air quality, water quality and availability, and protecting nature. Many new indicators have been developed and published since 2009. The CESI website ensures that federal, provincial, territorial, local and international trends are readily accessible and transparent to all citizens. It presents information through the use of graphics, explanatory text, interactive maps and downloadable data.

The federal government has released a number of reports on the state of the environment. These include The State of Canada's Forests Annual Report and annual Canada's Emissions Trends reports focusing on GHGs. In addition, Statistics Canada's environmental statistics programme produces data series on various components of natural capital (water, ecosystems, sub-soil minerals), natural resource use, as well as data on pollutant releases. However, there are challenges regarding the comparability and timeliness of published information, notably in the area of waste generation and management. Statistics Canada has also begun work to compile data on environmental protection expenditures (Chapter 3).

With regard to environmental information concerning private entities, the National Pollutant Release Inventory (NPRI) established under CEPA provides nationwide, publicly accessible information on annual releases to air, water and land, and disposal and recycling by industrial and commercial facilities. The Canadian Environmental Assessment Registry consists of both an internet site and project files. It was established to ease access to records related to EAs conducted at the federal level. Enforcement databases are also open to the public (Section 4.2).

5.3. Access to justice

Environmental petitions are a unique way for Canadian residents to bring their concerns and questions about environmental issues to the attention of relevant federal ministers and to obtain responses from them. The Commissioner of the Environment and Sustainable Development administers environmental petitions on behalf of the Auditor General of Canada and has issued a guide to the process. The commissioner posts summaries of environmental petitions received and responses given on the Office of the Auditor General of Canada's website. A total of 18 petitions were filed in 2015, covering such issues as climate change adaptation for national parks, implementation of a federal compliance strategy for transboundary waste regulations and concerns about Canada's continued use and import of asbestos (OAG, 2017). In addition, CEPA provides a mechanism through which the public can request an investigation of an alleged offence. If the minister fails to investigate, a member of the public can launch an environmental protection action against the alleged offender in the courts.

The Canadian public has a broad right to appeal decisions that affect the environment. The right of appeal against a permit or approval is specified in the statute authorising such a decision. Historically, many statutes only offered these appeal rights to the issuing agency and the applicant. In recent years, provincial legislatures have authorised third-party appeal rights. These appeals are usually held before administrative tribunals such as Alberta's Environmental Appeals Board or Ontario's Environmental Review Tribunal. In addition, most government decisions are subject to judicial review on issues of jurisdiction, error of law or denial of natural justice. Judicial review can be initiated in federal or provincial courts, depending on the identity of the government official who made the decision that is challenged. Over the last decade, the rights of public interest groups to bring judicial review

suits have expanded significantly. However, unlike the United States, Canada does not have provisions for citizen suits to seek court injunctions for the government to enforce environmental laws.

In all Canadian jurisdictions, an individual can commence a legal action against a polluter, owner or occupier for damages related to pollution. Some NGOs engage in direct action to draw attention to environmental issues. Indeed, NGOs such as Ecojustice and the Canadian Environmental Law Association maintain a complement of staff legal counsel to intervene in significant environmental cases (Tidball et al., 2016). According to the Environmental Justice Atlas, Canada has 21 environmental conflicts, placing it 23rd in the world. These conflicts are mostly related to fossil fuel and mineral ore extraction (EJOLT, 2016).

There are limited mechanisms to reduce significant financial barriers to justice on environmental matters (WRI, 2016). In February 2017, the federal government announced the reinstatement and expansion of the Court Challenges Program discontinued by the previous government in 2006. It will provide up to CAD 5 million of federal funds annually to help Indigenous organisations cover their legal costs in challenging legislation that they feel prejudices their rights (Leblanc, 2017). However, this funding will not be available to environmental NGOs.

5.4. *Environmental education*

Canada is well-known for actively promoting citizens' awareness in the area of biodiversity conservation. Provincial and local governments support local environmental organisations and volunteer programmes, such as the Conservation Volunteers programme. For example, the widely followed Yukon Biodiversity Awareness Month is one of several educational initiatives available to school children in this territory (Yukon Environment, 2016). In celebration of Canada's 150th birthday, Parks Canada is providing free access to national parks in 2017. ECCC also has a number of community action funding programmes that facilitate collective action and stewardship partnerships. These include the Aboriginal Fund for Species at Risk, which supports projects that protect habitat and contribute to the recovery of species at risk.

The federal government has actively engaged in promoting awareness of climate change impacts on health and provided information to help Canadians adapt. Health Canada's Climate Change and Innovation Bureau has developed a number of educational materials and guidance documents to help communities and individuals prepare for extreme heat events and protect the most vulnerable populations.

Education is a responsibility of sub-national governments. However, the federal government also supports environmental education in schools. For example, environmental statistics adapted for educational needs were published in 2015 as "teacher's kits" for different school levels. The Canadian Network for Environmental Education and Communication (EECOM) plays an important role in co-ordinating these efforts. EECOM is a national charitable network for environmental learning. Its members and associates include provincial, territorial and national environmental learning organisations representing government, NGOs, universities, schools and industry. Many initiatives to integrate environmental and sustainability aspects into school curricula in the provinces also come from civil society (Box 2.8).

About half of Canadian post-secondary education institutions have an environmental or sustainability policy. Quebec and British Columbia have the highest shares (85% and

Box 2.8. **Civil society groups advocate more environmental education in schools**

Environmental Education Ontario (EEON) is an advocacy group of education professionals formed in 2000 to improve the status of environmental education in the province. Its 2003 report "Greening the Way Ontario Learns" led the Ontario Ministry of Education to adopt a new policy framework (2009). It incorporated several environmental science and sustainability courses to the school curriculum, as well as environmental elements into other academic disciplines. EEON sets environmental education benchmarks not only for schools and universities, but also for environmental education at home, at work and in the community.

The Alberta Council for Environmental Education (an NGO established in 2006) created an Education Task Force in 2014. It has produced a Curriculum for Sustainable Future for the province's elementary and secondary schools. The curriculum outlines key concepts and learning outcomes in different academic subjects that would help make students literate in energy and environmental matters.

Source: ACEE (2016); EEON (2016).

67%, respectively), while only 13% of universities in Saskatchewan have such a policy. Over the past decade, the number of sustainability offices in Canadian universities has increased. These offices have focused primarily on the greening of operations (developing environmentally friendly procurement policies, sustainable transportation and food plans, etc.). However, many have also engaged in educational initiatives. In addition, there have been significant efforts to benchmark Canadian universities in terms of their commitment to, and performance on, sustainability. This includes the Sustainability Tracking Assessment and Rating System developed by the Association for the Advancement of Sustainability in Higher Education (Vaughter et al., 2015).

Recommendations on environmental governance and management

- Enhance institutional collaboration between the federal and provincial/territorial governments to reinforce synergies and reduce duplication of environmental management responsibilities, for example by extending provincial-territorial environmental framework agreements to areas requiring better cross-jurisdictional collaboration such as biodiversity conservation, water management, environmental assessment or land-use planning; expand the involvement of municipalities in vertical policy co-ordination; improve data management to better support decision making.
- Improve implementation of SEA at the federal level and introduce SEA requirements at the provincial level; ensure its application to regional and local land-use plans to better evaluate and address cumulative environmental effects of economic activities; enhance municipal capacity for land-use planning.
- Strengthen environmental assessment at the federal level by increasing transparency of the EA procedure and starting it at the early project design phase; ensure closer integration between EA and permitting at the provincial level.
- Implement integrated environmental permitting in all sub-national jurisdictions; promote the use of best available techniques through a holistic, cross-media approach to setting permit requirements; expand the use of sector-specific standardised requirements and simplified permitting regimes for facilities with low environmental risk.

Recommendations on environmental governance and management *(cont.)*

- Expand the use of administrative fines (instead of criminal penalties) for minor environmental violations; take account of economic benefit from non-compliance in determining the size of monetary penalties; develop enforcement policies with clear guidance on applying administrative and criminal sanctions proportionately to the seriousness of non-compliance; develop outcome-focused performance measurement of compliance assurance activities; ensure public disclosure of all enforcement data.
- Improve the procedure for consultation with Indigenous communities by starting engagement at the outset of the process; build their capacity to meaningfully participate in environmental decision making, particularly EA; clearly define and implement the concept of Indigenous communities' "free, prior and informed consent" with regard to land use and natural resource management.
- Enhance the quality and timeliness of information provided to the public; expand mechanisms to offer financial support for legal costs to facilitate access to justice on environmental matters; enhance the support for environmental education in secondary schools and universities.

Notes

1. Comprehensive Land Claim Agreements engage the federal, provincial governments and Indigenous peoples in governing natural resources on Indigenous lands. Self-government agreements set out arrangements for Indigenous groups to govern their internal affairs and address the structure and accountability of Aboriginal governments, their law-making powers and financial arrangements. With more than 2 300 identified obligations across all modern treaties in effect, ECCC is one of the primary departments responsible for Canada's implementation of modern treaties with Indigenous peoples.
2. Although Quebec supports the general objectives of AQMS, it does not implement the system since it includes federal industrial emission requirements that duplicate Quebec's Clean Air Regulation.
3. Revenues from federal environmental fines are channelled to the Environmental Damages Fund administered by ECCC. The revenues are spent primarily on environmental restoration projects, but also on research and development and educational activities.
4. The agreements to limit indoor use of 2-butoxyethanol (2007-12), to reduce air emissions from railway locomotives (2007-10) and to achieve verifiable reductions in the use, generation, and release of substances in the automotive parts sector (2002-07) had mixed results (ECCC, 2016a).
5. The EDI assessment, conducted in 2014, was limited to the federal level. It did not assess laws, regulations or practices of Canada's provinces and territories.

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PART I

Chapter 3

Towards green growth

While progress towards green growth has been relatively slow since the last review in 2004, Canada is now building strong policy frameworks and measures to support its green growth transition. It is also establishing new collaborative efforts across federal, provincial and territorial governments. This chapter presents Canada's progress towards green growth, considering environmentally related taxation, other economic instruments, investments in environmental infrastructure and services, the state of eco-innovation and markets for environmental goods and services, measures to address the social consequences of green growth, and the interaction between environment and international trade and development assistance.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Laying the ground for green growth transition

Relative to most OECD member countries, Canada's economic growth is more reliant on the use of both renewable and non-renewable natural capital. Industries such as fossil fuel and mineral extraction, and agriculture, forestry, fishery and hunting accounted for 10% of gross domestic product (GDP) in 2015. In the same year, exports of farm, fishery, energy, metal, mineral and forest products accounted for around 40% of exports (Chapter 1). The fall in oil prices since a peak in 2008 is leading to an economic adjustment, with some shifting of productive factors from resource and related sectors to other parts of the economy. Nevertheless, Canada faces challenges in transitioning to a more environmentally sustainable economic model. Canada still is one of the most energy- and resource-intense economies in the OECD, and greenhouse gas (GHG) emissions have declined only marginally since 2000 (Chapter 1). Large energy-intensive industries, such as the oil sands sector, are expected to remain key contributors to GDP growth.

Since the last *Environmental Performance Review* (EPR) in 2004, Canada has developed two major policy frameworks that support the transition to green growth: a Federal Sustainable Development Strategy (FSDS) in 2010 and the Pan-Canadian Framework on Clean Growth and Climate Change (PCF) in 2016. The 2012 Air Quality Management System constitutes another important collaborative action framework, which is helping advance federal, provincial and territorial policy (see also Chapters 1 and 2). It is too early to evaluate the results of these frameworks, or determine whether they will improve Canada's green growth performance. Effective and timely implementation, combined with mechanisms for policy evaluation and adjustment and explicit approaches to address social considerations, will help move Canada towards a green growth path. An important next step could be to extend these frameworks to other pressing green growth issues requiring policy action across governments, such as achieving the Aichi targets related to protected areas or shifting towards integrated spatial planning approaches.

1.1. *Canada's Federal Sustainable Development Strategy*

At the federal level, the FSDS is the main policy framework guiding sustainable development and green growth. It outlines sustainable development priorities, goals, targets and associated actions to promote clean growth, ensure healthy ecosystems and build safe, secure and sustainable communities. The 2008 Federal Sustainable Development Act requires the Minister of the Environment to develop a whole-of-government strategy every three years. The act also identified 26 federal departments and agencies that prepare their own strategies to comply with, and contribute to, the FSDS. Fifteen additional organisations contribute to the FSDS voluntarily (ECCC, 2016a). A Sustainable Development Office within Environment and Climate Change Canada (ECCC) monitors progress. Individual federal departments were required to develop their own sustainable development strategies already prior to 2008. However, these were lacking an overarching strategy that would guide and make sense of individual pieces (SCESD, 2016).

The first two FSDSs were criticised for being simply a list of relatively unambitious ongoing environmental measures (SCESD, 2016). The 2016-19 FSDS attempts to be more strategic and forward looking. It includes 13 goals linked to the UN Sustainable Development Goals (SDGs), as well as targets and short-term milestones to achieve them. For each goal and target, it identifies responsible ministers, thereby supporting the alignment of sectoral policies and environmental objectives. For example, the Minister of Infrastructure and Communities implements the target related to investment in green infrastructure and the Minister of Innovation, Science and Economic Development shares responsibility with the Minister of Natural Resources for investment in clean energy innovation. Current legislation requires the strategy to focus on environmental objectives. However, planned legislative revisions provide an opportunity to consider socio-economic implications of a green growth transition. This would address issues such as labour markets, skills, low-income households and the competitiveness of firms.

To monitor progress, the FSDS relies on existing and new quantified indicators. They cover trends relating to climate action, clean growth, clean energy, coasts and oceans, lands and forests, lakes and rivers, clean air and clean drinking water. An ambitious set of new indicators is being developed to measure the contribution of the clean technology sector to GDP and jobs, or the benefits of water infrastructure investments on reducing water loss and improving water quality, for example. Such indicators will be important to securing continued support for action in these areas. As these indicators are developed, Canada could consult with the OECD and other bodies to ensure they will be internationally comparable.

The strategy only applies at the federal level. However, provincial and territorial governments, which have wide-ranging responsibilities in Canada (Chapter 2), need to be partners in elements of the strategy. Several sub-national jurisdictions have their own sustainable development strategies or green growth plans, which vary in their approach and comprehensiveness. Quebec's Sustainable Development Strategy 2015-20, for example, includes economic, environmental and social goals and objectives. Nova Scotia's approach is more focused on the environment, with linkages to economic objectives.

1.2. Pan-Canadian Framework on Clean Growth and Climate Change

Between 2004 and 2016, the provinces were the primary driving force behind Canada's climate change policy (Chapter 4). The country lacked an overarching national plan to meet its GHG reduction targets. In December 2016, however, the federal government and 11 of 13 provinces and territories agreed on a Pan-Canadian Framework on Clean Growth and Climate Change (PCF). This framework, which was developed in consultation with Indigenous groups, represented a major achievement in Canadian climate policy. The PCF is designed to achieve Canada's Nationally Determined Contribution (NDC) to the Paris Climate Change Agreement, which is a 30% reduction in GHG emissions relative to 2005 levels by 2030. The leaders agreed to report regularly and transparently on progress towards the goal. Details on how this will be carried out were still under development at the time of writing. The creation of an independent institution with a strong analytical capacity to monitor and advise governments on implementation of the PCF would help promote effective decision making and reasoned discourse.

The PCF supports green growth through its focus on both economic growth and climate change. It promises to grow the economy, while reducing emissions and building resilience to adapt to a changing climate. The four main pillars of the PCF are: pricing carbon pollution (Section 2.3); complementary climate actions such as phasing out coal-fired power and

regulating building and vehicle efficiency; measures to adapt to the impacts of climate change and build resilience; and actions to accelerate innovation, support clean technology and create jobs (GoC, 2016a). Moreover, Canada is one of six countries that have submitted mid-century long-term plans to the UN Framework Convention on Climate Change (UNFCCC).

2. Greening the system of taxes and charges

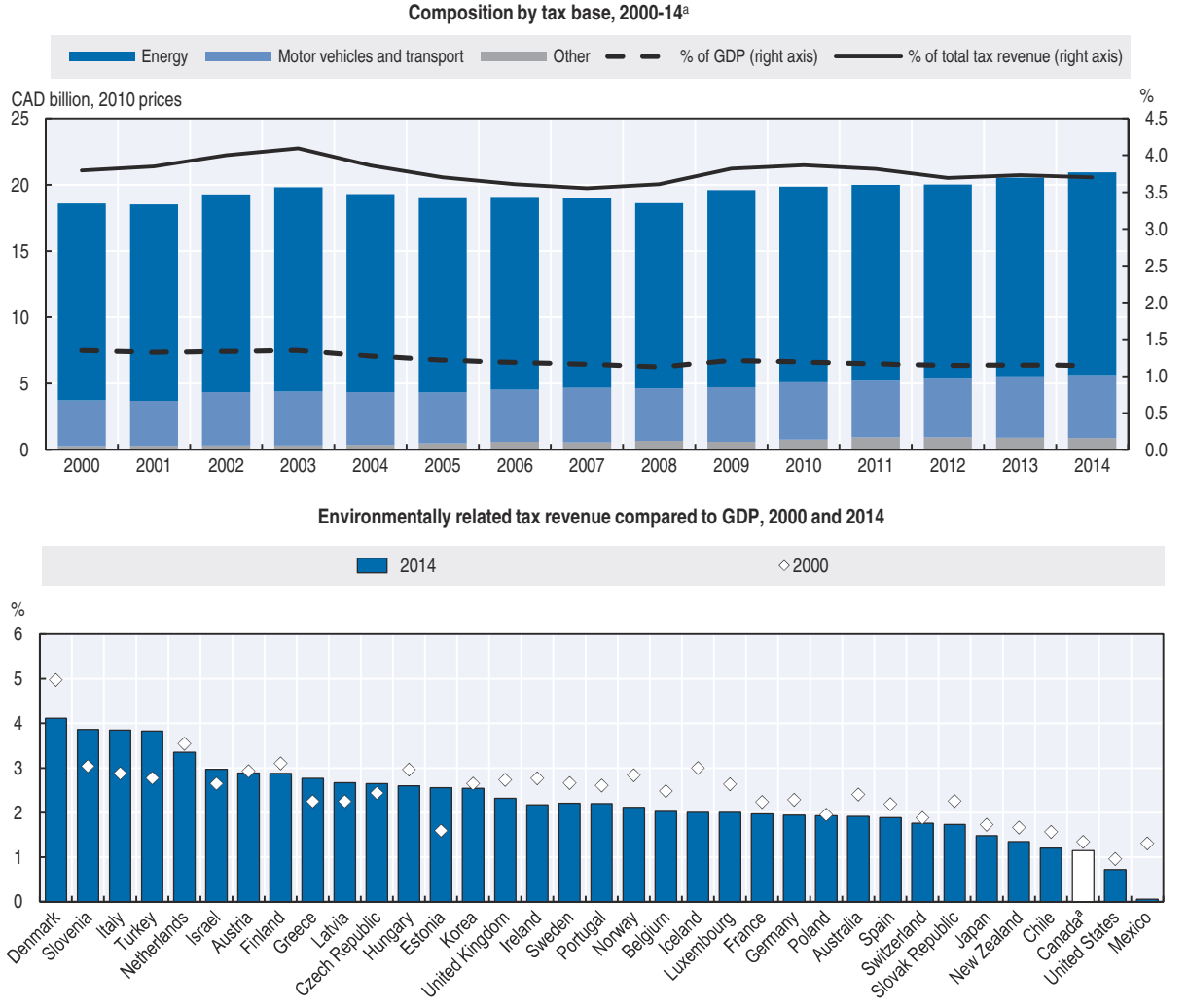
Weaker economic activity, driven by weakening US demand and lower oil prices, has decreased government revenue. At the same time, an ageing population, mounting infrastructure gaps and the need to strengthen the skills and innovative capacity are raising pressures on public spending. All levels of government are facing some degree of fiscal challenge.

Taxation in Canada is a shared responsibility between the federal government and provincial and territorial governments. The federal and provincial/territorial governments impose personal and corporate income taxes, as well as general sales or value-added taxes (except Alberta and the territories). Provinces, the Northwest Territories and the Yukon collect royalties on fossil fuel and mineral extraction within their jurisdiction.[1] Through an equalisation programme, the federal government makes annual transfers to lower-revenue provinces and territories to ensure that Canadians in every province and territory have access to similar public services. The federal government also makes transfers to provinces and territories for specific purposes such as health care, social programmes and infrastructure. Municipality revenue largely comes from property taxes, user fees and charges, transfers from provincial and territorial governments and revenue from the federal Gas Tax Fund.[2]

There is scope to introduce more environmental taxation in Canada to create a new source of revenue and to drive the shifts in behaviour and investment needed to achieve environmental goals. The country has historically had lower use of environmental taxation than other OECD member countries. In 2014, for example, environmental tax revenues reached 1.1% of GDP, the third lowest value in the OECD (Figure 3.1). Revenues increased slightly in real terms over the period, with a dip in 2007/08, likely as a result of the dampening effects of the global financial crisis and high oil prices on fuel consumption. As in most OECD member countries, taxes on energy use (notably from fuels used for transport) represent the largest source of environmentally related tax revenue. Revenue from other taxes (e.g. waste-related taxes) grew between 2000 and 2014, but remains small (Figure 3.1).

The 2004 EPR of Canada stated that "market-based instruments are insufficiently used to integrate environmental concerns into sectoral policies. Too much emphasis is given to soft instruments like voluntary guidelines or partnerships". The introduction of carbon pricing in several provinces and the move towards federal carbon pricing in 2018 under the PCF (Section 2.3) represent a major advancement in greening Canada's tax system. It will correct currently weak price signals from Canada's energy tax system, which leaves large amounts of energy use (e.g. for electricity generation, industrial processes and heating) and associated pollution untaxed. However, even with the introduction of carbon pricing, federal and provincial government could make greater use of taxes and other economic instruments to influence vehicle choice and driving behaviour, and to limit resource use and pollution. Further work is also needed at the provincial and territorial level to phase out remaining fossil fuel subsidies, including tax exemptions.

Figure 3.1. **Environmentally related tax revenues in Canada remain among the lowest in the OECD**



a) Data include federal and partial provincial revenues.
Source: OECD (2017), "Environmental Policy Instruments", *OECD Environment Statistics* (database).

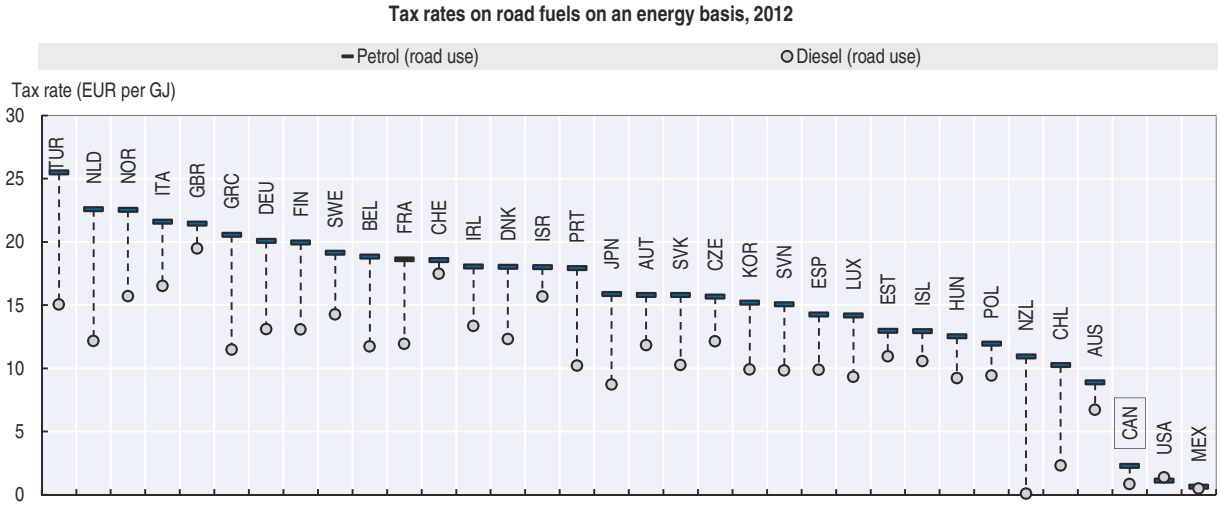
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2.1. Taxes on energy use

Canada has a complex system of energy taxation, with taxes applied at the federal and provincial levels, as well as the municipal level in some cases. At the federal level, excise taxes apply only to certain transport fuels. Gasoline, which accounts for half of energy used in transport, is subject to a federal excise tax of CAD 0.10 per litre, which is low in comparison to most other OECD member countries. Diesel (including biodiesel) is taxed at an even lower rate (at CAD 0.04 per litre), despite the greater environmental harm in terms of GHG emissions and certain air pollutants (Figure 3.2). Diesel passenger vehicles represent a relatively small share of the vehicle fleet in Canada in comparison to other OECD member countries. However, their popularity has been growing in recent years. Diesel is also prominently used in northern, remote and Indigenous communities for electricity generation and space heating, which uses are generally not subject to excise taxation.

Provinces levy additional excise taxes on energy products. Excise taxes on energy therefore vary across the country in scope, level and characteristics. In most instances, provincial product-specific tax rates on energy products are higher than the federal excise tax rate (OECD, 2013); some provinces include fuel use in their carbon pricing systems.[3] The average gasoline excise tax in 2016, including federal and provincial excise taxes, was CAD 0.34 per litre. The average non-commercial diesel excise tax was CAD 0.26 per litre, and the average commercial diesel excise tax only CAD 0.05 per litre (IEA, 2017a). Planned carbon prices will begin to close the gap between gasoline and diesel, given the higher carbon content of diesel fuel. However, increases in excise tax rates would be needed to accelerate the transition and fully eliminate the differential.

Figure 3.2. **Federal tax rates on petrol and diesel for road use are relatively low**



Note: Tax rates are as of 1 April 2012, except 1 July 2012 for AUS. Figures for CAN and USA include only federal taxes. NZL applies a road-user charge to diesel that is not included in the figure. Tax rates converted using standard carbon emission factors from the Intergovernmental Panel on Climate Change and energy conversion factors from the International Energy Agency (IEA).
Source: Adapted from OECD (2015), *Taxing Energy Use*.

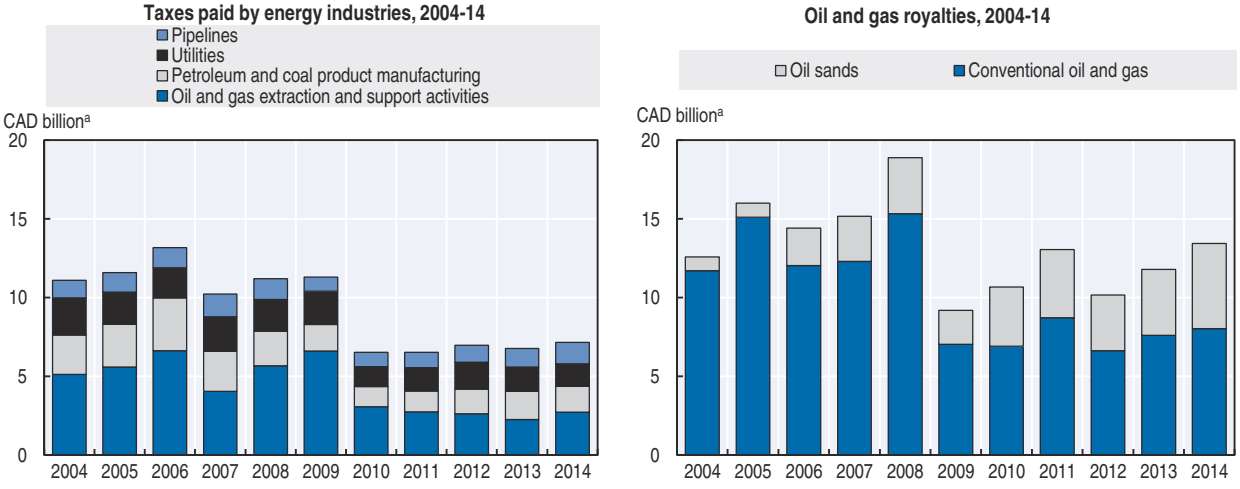
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Energy used for electricity production or residential and commercial space heating is generally not taxed federally (apart from the federal value-added tax). Neither is the consumption of electricity taxed federally (except where electricity is used in the operation of a vehicle). Electricity prices in Canada are, on average, among the lowest in the OECD, even though there is significant price variation across provinces (Chapter 4). This is largely a result of electricity being provided by provincially-owned utilities, with regulated prices, in the majority of provinces, as well as a strong desire to keep electricity rates low for households and businesses. Low electricity prices are a key competitive advantage. However, they should be based on the cost of production and reflect a return on capital and the cost of externalities such as air pollution and GHG emissions resulting from generation. Most provinces tax propane (used for heating, appliances and some vehicles). But a number of provinces do not tax natural gas, coal and coke (OECD, 2013). Taxes on heating fuels reflective of environmental externalities help drive fuel switching and build greater thermal efficiency. The move towards carbon pricing will change the taxation of fuels as provinces are expected to include fuels within their systems.

2.2. Taxes on energy production[4]

Taxes and royalties paid for energy production in Canada have fluctuated over time, particularly with the drop in oil prices. Oil and gas extraction pays the largest share of tax, followed by petroleum and coal product manufacturing and sales taxes from electric utilities (Figure 3.3). Total taxes paid by energy industries averaged about CAD 8.6 billion per year between 2008 and 2012 (NRCan, 2014).

Figure 3.3. **Taxes and royalties paid by energy industries fluctuate from year to year**



a) At 2010 prices. Taxes include federal and provincial corporate income taxes and indirect taxes
Source: Statistics Canada (2017), "Table 180-0003", CANSIM (database); Country submissions.

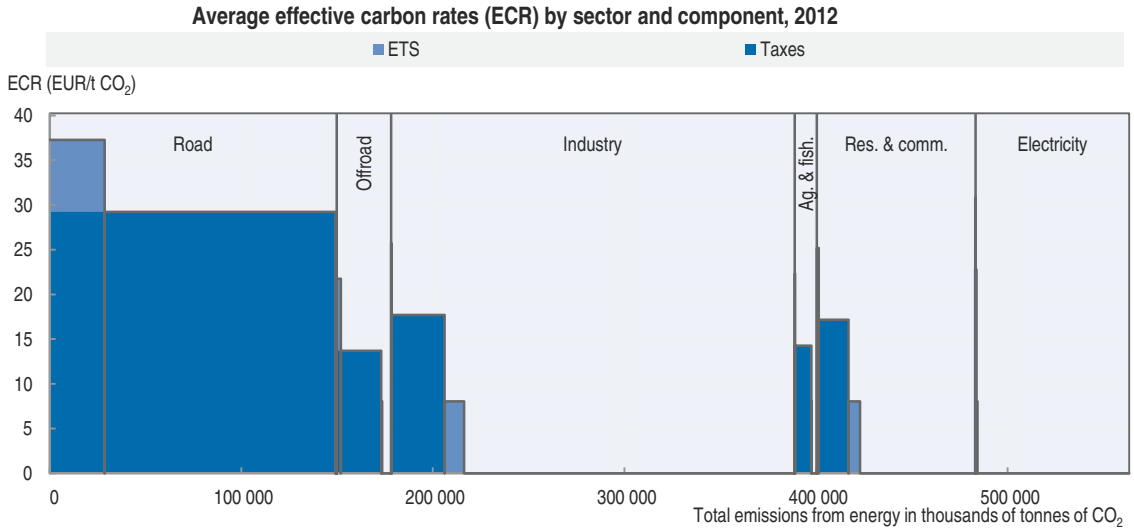
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The oil and gas sector also contributes to government revenues (mainly provincial) through Crown royalties (which provide a share of the value of oil and gas extracted to the government) and land sales (which oil and gas companies pay to governments in order to acquire resource rights on specific properties). Revenue from royalties and land sales averaged about CAD 16.5 billion per year between 2008 and 2012 (Figure 3.3). Although oil sands production now exceeds conventional oil and gas production in Canada, the latter still accounts for the majority of royalty and land sale revenue. In Alberta, however, where oil sands production takes place, the majority of royalty revenue is now from oil sands. Alberta is also expected to reform its climate change regulations covering the oil sands sector at the end of 2017, which will increase the carbon levy imposed oil sands producers that have higher GHG emissions per barrel of oil produced relative to an established benchmark (Box 3.4).

2.3. Carbon pricing

Between 2004 and 2016, Canada made slow progress in extending and increasing effective carbon prices across sectors. In 2012, it had among the lowest effective carbon rates on CO_2 from energy use in the OECD (OECD, 2013). This reflects weak energy taxation, as well as lack of direct carbon pricing mechanisms in most provinces at the time. As in other OECD member countries, the effective carbon rate in Canada was highest in road transport (where nearly all carbon emissions are covered). An effective carbon rate covered only a small share of CO_2 emissions from industry, and at much lower levels than in road transport (although the sector does represent a large share of CO_2 emissions). Emissions from electricity generation were almost not covered at all in 2012 (Figure 3.4).

Figure 3.4. **Canada had relatively low effective carbon rates across sectors in 2012**



Note: Tax rates as of 2012, energy use as of 2009. Tax rates include British Columbia's carbon tax and Quebec's emissions trading system.
Source: OECD (2016), *Effective Carbon Rates: Pricing CO_2 through Taxes and Emissions Trading Systems.*

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By mid-2017, the four most populous provinces representing 86% of Canada's population and 81% of emissions had carbon pricing regimes in place (British Columbia, Quebec, Alberta and Ontario). British Columbia introduced a carbon tax in 2008 with revenue recycling to reduce corporate and personal income taxes. The OECD heralded the BC reform as text-book climate policy. The tax was introduced at CAD 10 and gradually increased to CAD 30 in 2012. Quebec introduced a cap-and-trade system in 2013, which was linked to that of the US state of California in 2014 – one of the first sub-national cross-border linkages in the world. Ontario's cap-and-trade system, which began in 2017, will be linked to that of Quebec and California by 2018. Alberta uses a hybrid system with an economy-wide carbon price of CAD 20 per tonne as of 2017 (set to rise to CAD 30 per tonne in 2018) combined with a trading-scheme for large emitters (Box 3.4). Table 4.1 in Chapter 4 summarises the main characteristics of these pricing mechanisms. Most remaining provinces and territories have expressed support for implementing carbon pricing under the framework of the PCF (GoC, 2016a).[5]

The introduction of Canada-wide carbon pricing is one of the key elements of the PCF. The PCF sets a federal benchmark for provincial/territorial implementation of carbon pricing: for jurisdictions with a price-based system, such as a carbon tax, the benchmark is set at CAD 10 per tonne in 2018 with a commitment for it to rise by CAD 10 annually to CAD 50 per tonne by 2022. Provinces with cap-and-trade regimes will need a 2030 target equal to or greater than Canada's national 2030 target (30% below 2005 levels) with declining annual caps to at least 2022 that correspond with projected emission reductions resulting from the carbon price that year in price-based systems. If provinces and territories do not meet the benchmark, the federal government will introduce a price-based system with revenues returned to the jurisdiction (GoC, 2016a). Discussions about the exact design of the federal benchmark are ongoing. A discussion document, released by the federal government in May 2017, proposes a combination of a carbon levy with an output-based pricing system for large emitters. The latter intends to address competitiveness and carbon leakage risks for emissions-intensive, trade-exposed sectors (ECCC, 2017).

Full implementation of carbon pricing under the PCF will help the country catch up with other OECD member countries. In 2012, less than half of Canadian CO_2 emissions were covered by an effective carbon rate (OECD, 2016e). The government estimates that the PCF would expand the coverage to 70-80%, a share similar to that of leading OECD peers (e.g. Germany, the Netherlands, Switzerland or the United Kingdom; see OECD, 2016e for country-level detail). The price increase of the federal benchmark to CAD 50 in 2022 is welcome. However, the level of the average effective carbon price on Canadian emissions would likely remain moderate in international comparison. The highest effective carbon price in most OECD member countries in 2012 was already twice as high as the highest effective carbon price that is projected for Canada in 2022.[6]

The move towards federal carbon pricing is a significant achievement for Canada, given divisive debates over the past decade on carbon pricing and policies needed to meet commitments on GHG reductions. However, there are signs of challenges ahead. Saskatchewan has threatened to take the federal government to court if it imposes carbon pricing in the province. The province fears that emissions-intensive, trade-exposed sectors in that province – such as oil and gas and potash – would lose ground to international competitors if carbon pricing were implemented. While Manitoba has committed to carbon pricing, it has not yet signed on to the PCF given unresolved grievances with the federal government relating to health care funding. British Columbia, which has carbon pricing in place and signed on to the PCF, insists on reviewing pan-Canadian progress in 2020 prior to raising its carbon tax above the current CAD 30 per tonne. The province is concerned that provisions in the carbon pricing benchmark for cap-and-trade systems are not as stringent as those imposed on price-based systems. As a result, federal, provincial and territorial leaders agreed on an expert assessment that would compare the stringency and effectiveness of the different carbon pricing systems across Canada by early 2022 (GoC, 2016a). Such an assessment should be done by an independent third party with strong analytical capacity. An interim report will be completed in 2020. As an early deliverable, the review will assess approaches and best practices to address the competitiveness of emissions-intensive, trade-exposed sectors.

As the federal benchmark price increases, frictions may arise, creating the pressure for convergence of the different pricing systems. For example, businesses in carbon tax systems may push for access to low-cost reductions similar to neighbouring provinces; investors in cap-and-trade systems may be interested in the price certainty provided in carbon tax jurisdictions; and firms operating in multiple provinces may push for reduced transaction costs. The next challenge for the federal, provincial and territorial governments will therefore be to work towards stronger co-ordination or, eventually, convergence of systems in order to have similar carbon prices and coverage applying in all jurisdictions. This would reduce transaction costs, improve efficiency and level the playing field for business. There are various ways to achieve this. One possibility is a pan-Canadian offset system where entities can purchase offsets from projects throughout the country that meet agreed upon criteria. Another option is to facilitate trading among sub-national cap-and-trade systems (including at the sector level). Entities in carbon tax jurisdictions could be allowed to purchase permits from cap-and-trade systems to reduce their total emissions used in calculating tax payments. A third possibility is to align price ceilings and floors in cap-and-trade systems to carbon taxes in other Canadian jurisdictions. Maintaining the consensus established in the PCF will be the initial priority. However, it will be important to leave the door open to convergence down the road.

The linkage of Quebec and Ontario to California may also become an issue. Canada will need to reach an agreement with the United States to ensure that credits purchased from California will count towards Canada's national GHG inventory to avoid double counting. Current uncertainty about US climate policy is a challenge for Canada for several reasons. The United States is the destination for about 70% of Canada's exports; it is a major source of competition to Canadian businesses; and Canada has aligned environmental policies such as vehicle standards with those of the US government.

Across successive governments over the past two decades, Canada has agonised how moving forward with climate policy could affect the country's competitiveness. This is despite the growing empirical evidence that suggests that carbon pricing does not lead to significant competitiveness impacts (Arlinghaus, 2015; Flues and Lutz, 2015). Anxiety is heightened by uncertainty about the direction of US policy. However, competitiveness concerns need not slow plans for carbon pricing. Carbon pricing can be designed to minimise the risk to emission-intensive exporters. Revenue can be recycled into tax cuts in other areas such as corporate or personal taxation, for example. Some of the tradable emissions permits could also be allocated freely. As well, output-based subsidies, and technology and infrastructure investments, could make it easier and less costly to reduce emissions. In fact, provincial regimes all use at least one of these approaches to limit competitiveness risks (see Table 4.1 and Box 3.4 for description of Alberta's output-based allocation approach for large emitters). In the near term, these kinds of measures can be essential to political and public acceptability. Over time, however, they would ideally be reduced. In the long run, carbon pricing will also help support economic growth by driving innovation and technology deployment that can improve competitiveness, and by avoiding costly lock-in of emissions-intensive infrastructure.

2.4. Transportation taxes

Taxes on vehicles

At the federal level in Canada, there is an excise tax on fuel-inefficient passenger vehicles called the "Green Levy", which replaced a heavy vehicle tax in 2007. The tax applies to passenger vehicles only, with exemptions for pickup trucks, vans for ten or more passengers, ambulances and hearses. The tax is based on a vehicle's average weighted fuel consumption (55% for cities and 45% for highways), and affects vehicles with a rating of 13 or more litres per 100 km. The tax starts at CAD 1 000 per vehicle and escalates to CAD 4 000 for vehicles with a rating of 16 or more litres per 100 kilometres (CRA, 2007). In practice, the tax mainly applies to luxury vehicles, race cars and large sport utility vehicles (SUVs).

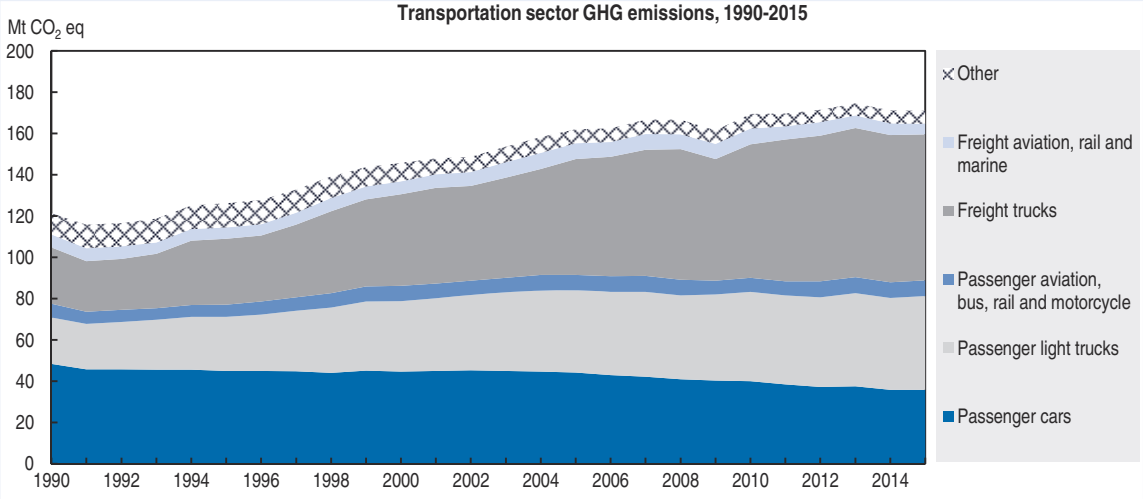
With the high purchase prices of these vehicles, the tax is unlikely to alter purchasing decisions. Further, the tax does not capture many vehicles that are among the worst emitters in their category as they fall just below the threshold of 13 litres per 100 km. The exemption of pickup trucks is also problematic, as these cars represent some of the best-selling vehicles in Canada (Box 3.1). Low petrol and diesel prices (see previous section) further dilute incentives to purchase fuel-efficient vehicles. Carbon pricing is not expected to result in a significant additional incentive in the near-term given the relatively small and gradual impact on fuel prices. In the past, the federal government provided between CAD 1 000-2 000 towards the purchase or lease of fuel-efficient vehicles, but this practice ended in 2010 (ESDC, 2011).

Provincial governments charge for vehicle registration, but in most provinces, the charge is not linked to the emissions or energy use performance of the vehicle. The system of transportation taxation is due for a review considering new developments in provincial carbon

Box 3.1. **Pickup trucks and SUVs are becoming increasingly popular in Canada**

Canada's transportation sector is responsible for around 24% of GHG emissions in Canada. It is also a major contributor to local air pollution. While passenger car emissions are declining, emissions from passenger light trucks, such as pickup trucks and SUVs, and freight trucks are growing (Figure 3.5). In 2015, four of the top ten-selling vehicles in Canada were pickup trucks and two were SUVs (Chase, 2016). Since 1990, the number of light trucks has increased more than three times beyond the overall increase in the fleet of passenger cars. Pickup trucks and large SUVs used to be primarily for work-related purposes. In recent years, however, the trend has been towards luxury pickup trucks and SUVs for personal use.

Figure 3.5. **Passenger light trucks are a growing source of transportation emissions**



Note: GHG emissions by Canadian economic sector.
Source: ECCC (2017), *National Inventory Report 1990-2015.*

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pricing, the proposed federal clean fuel standard (Chapter 4), possible changes in US vehicle GHG standards, and emerging transportation technology. There is scope to reform transport taxes to optimise incentives for individuals and businesses to make more environmentally beneficial choices in vehicles and driving behaviour. This would also provide an opportunity to identify and address overlapping requirements or distortionary interactions.

Road congestion

The use of congestion pricing and road tolls in Canada remains limited. Some provinces and municipalities have introduced different forms of congestion pricing or road tolls to limit congestion or to finance infrastructure investments. Tolls have been introduced on one Ontario highway (407), and on select bridges in Quebec, Nova Scotia and British Columbia. In the city of Calgary, Alberta, parking prices vary across 27 discrete areas to shift parking from congested areas to those with underused spaces (see also Box 4.5 in Chapter 4). The city of Toronto also proposed new tolls on two main highways into the city to help fund infrastructure investments, but the Ontario provincial government rejected the proposal. Canada should pursue opportunities to expand congestion pricing, wherever possible, to reduce congestion, lower pollution and finance infrastructure investments. Opportunities for congestion pricing exist in Vancouver and Montreal on bridges and tunnels, and in

Calgary and Toronto for high-occupancy toll lanes (Ecofiscal Commission, 2015). Canadian governments at the municipal, provincial and federal levels should work together to expand the use of congestion pricing, starting with pilot projects.

Company cars

Canada is the best performing country in the OECD when it comes to adequately taxing the benefit provided from company cars for personal use, so as to ensure that employees bear the cost of driving unrelated to the job. Only 8% of Canada's registered private vehicles are company cars, a share much smaller than in other OECD member countries such as France (32%) or Sweden (48%). Canada's tax system captures the highest proportion of the benefits of company cars. The taxable benefit of the personal use of company cars is calculated based on a percentage of their capital cost (2% per month) combined with distance travelled (charge per kilometre driven for personal use). Canada does not, however, differentiate its tax treatment based on a company car's environmental impact. Belgium, Norway and the United Kingdom consider the environmental impact of the car in their tax treatment, using CO_2 ratings, fuel type or cylinder capacity (Harding, 2014a).

2.5. Economic instruments to limit resource use and pollution

Canada has made progress in using economic instruments to limit resource use and pollution. However, there remains significant scope for further action, including in the area of adequate water and waste pricing, promotion of biodiversity conservation and sustainable use, and reduction of air and water pollution. The level of taxation on resources consumption and pollution often remains too low to bring about behavioural change. Economic instruments can offer a cost-effective opportunity to improve environmental outcomes, particularly in areas at risk due to resource scarcity or pollution. However, governments in Canada are reluctant to impose additional costs on businesses and households for fear they will lower attractiveness for investment or lead to public backlash.

Air pollution

Canada has one of highest ratios of NO_x, SO_x or particulate matter emissions to GDP in the OECD (Chapter 1). The 2004 *Environmental Performance Review* (EPR) of Canada recommended further reductions in air emissions using the most cost-effective available policy measures, including emissions trading and charges. The federal government and most provinces have taken a regulatory approach to air pollution, including under the federal-provincial-territorial Air Quality Management System (Chapter 1). Ontario, however, has a cap-and-trade system in place for NO_x and SO_2 for the electricity sector and in seven industrial sectors. For its part, Alberta has a baseline-and-credit system in place for NO_x and SO_2 from thermal power generation. The systems have contributed to a 56% and 41% reduction of SO_x emissions and a 53% and 13% reduction of NO_x emissions in Ontario and Alberta, respectively. Still, the two provinces continue to be the highest emitters in Canada of both pollutants. Plans to close coal plants and improve energy efficiency driven by carbon pricing and other measures will help reduce air pollutants further. However, additional action will be needed, particularly in urban and industrial centres where emissions are increasing or air quality is of concern.

Waste

Waste pricing is limited in Canada, although provinces and territories have legislated extender producer responsibility schemes, under which levies are applied to certain

products (e.g. beverage containers) (Chapter 1). Quebec has a comprehensive scheme to improve re-use and recycling rates, charging a "royalty" on material placed in landfills. Manitoba, and several municipalities (including Toronto), also have waste disposal fees (Giroux, 2014). Still, several actions could help reduce the relatively high levels of waste per capita in Canada and stimulate waste reuse. Waste disposal fees could be expanded, for example, while currently low landfill fees could be increased. If taxes or pricing for the landfill alternative were higher, for example, neighbouring municipalities would be encouraged to use excess capacity at Edmonton's new state-of-the-art waste management facility (see Chapter 4). These practices could be combined with better measurement of waste generation, and tax incentives for use of recycled materials or repairing used goods.

Water and wastewater

Water pricing in Canada does not come close to reflecting the environmental cost of water use. Nor does the country raise the revenue needed to replace deteriorating water infrastructure (FCM, 2016). In addition, irrigation water fees are set based on the land area irrigated, instead of the volume of water used. This provides no incentive to introduce more efficient water irrigation technologies (ECCC, 2013). Some signs of progress include a shift towards pricing tied to the volume of water use and full cost-recovery pricing in some water and sanitation utilities. In addition, water trading has been introduced in some regions with water scarcity (e.g. Alberta's South Saskatchewan River basin).

For the most part, Canada relies on regulations to address water pollution. Notable exceptions include British Columbia's charge for agricultural inputs and discharge, and Quebec's industrial wastewater and water effluent charge. Some water quality trading initiatives also take place in Ontario, such as the Lake Simcoe Phosphorus Offset Program. Greater use of water pollution pricing in Canada could be informed by experience in Europe, such as the Netherlands' levy on water pollution.

Biodiversity conservation and sustainable use

Frameworks for biodiversity offsets are largely in place at the federal level and in several provinces, yet their application has been limited to date. The 2002 Species at Risk Act provides for biodiversity offsets; and amendments to the Fisheries Act in 2012 opened the door for offsets in relation to projects that impact negatively on fish. In 2012, ECCC released an Operational Framework for the use of Conservation Allowances, to help guide increased interest in using the tool (OECD, 2016a).

Several pilot projects similar to payment for ecosystem services are in place in Canadian provinces. The Alternative Land Use Services programme, for example, provides payments to participating landowners in six provinces to reward positive contributions to clean air, water and biodiversity through land management practices.

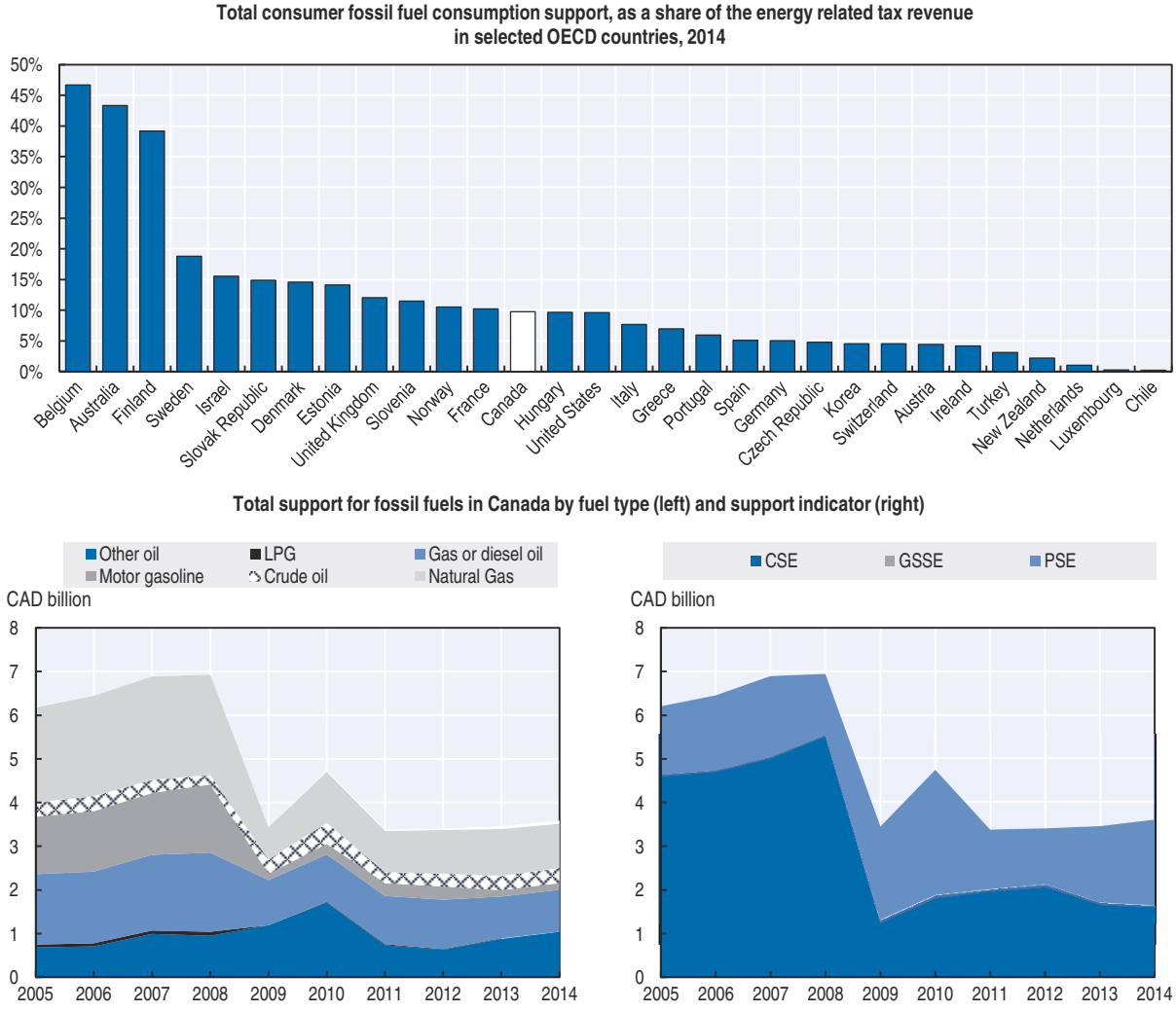
While few taxes are used for biodiversity purposes, there are licensing fees for commercial fish harvesters tied partially to the value of their catch. However, the Auditor General of Canada has recommended a review of these fees to better reflect the market value of the catch (OAG, 2008). There are also stumpage fees charged for the right to harvest timber on land owned by provincial or federal governments. The United States has contended the fees are too low relative to the market-based fees paid by their firms on private land.

2.6. Removing environmentally harmful subsidies

Support to fossil fuel production and consumption

As a member of the G7, Canada committed in May 2016 to "the elimination of inefficient fossil fuel subsidies" by 2025, and reiterated this commitment at the June 2016 North American Leaders Summit. Canada's fossil fuel support was reduced by almost half between 2005 and 2014 (Figure 3.6). This was driven by a significant reduction in consumer support, largely attributable to Ontario's removal of its sales-tax exemptions for energy products. Over the same period, producer support increased (Figure 3.6). This is despite a number of federal tax reforms of how certain capital expenses for fossil fuel extraction are treated. In the 2007 federal budget, Canada began to phase-out the accelerated capital cost allowance tax benefit for oil sands production. Budget 2011 announced changes to align tax

Figure 3.6. **Fossil fuel support has decreased, but both consumption and production support remains**



Note: CSE=Consumer Support Estimate, PSE=Producer Support Estimate, GSSE=General Services Support Estimate. LPG stands for Liquefied petroleum gases.
Source: OECD (2016), "OECD Inventory of Support Measures for Fossil Fuels", *OECD Environment Statistics* (database); OECD (2016), "Green Growth Indicators", *OECD Environment Statistics* (database).

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deduction rates for intangible costs in the oil sands sector with rates in the conventional oil and gas sector. Budget 2012 announced the phase-out of the Atlantic Investment Tax Credit for investments in the oil and gas and mining sectors. Budget 2013 announced the phase-out of the accelerated capital cost allowance for mining and reduction in the deduction rate for pre-production mine development expenses. Budget 2016 allowed the accelerated capital cost allowance for facilities that liquefy natural gas to expire scheduled in 2025. And Budget 2017 modified the tax treatment of successful oil and gas exploratory drilling and removed the tax preference for small oil and gas companies exploration expenses (Finance Canada, 2017).

According to the OECD Inventory of Support Measures for Fossil Fuels, some CAD 3.6 billion in fossil fuel subsidies remained in place in 2014, targeting mostly oil and natural gas fuels (Figure 3.6). Provincial and territorial fossil fuel support makes up the majority of remaining support in the OECD inventory. These include measures such as Alberta's Crown Royalty Reductions and provincial tax credits for drilling; tax exemptions for fuel use in farming, fishing and other activities; as well as energy cost rebates for low-income households. Provincial and territorial governments will need to be brought into discussions on reducing fossil fuel subsidies in order to meet Canada's 2025 commitment.

Support for agricultural production

Canada has lowered subsidies to agriculture production since 2004. Producer support, measured as a percentage of gross farm receipts, has consistently been below the OECD average. However, a relatively large share (70%) takes the form of the most distorting support, such as price supports that encourage production.[7] The OECD has consistently recommended that Canada shift the policy focus from price support towards facilitating the adoption of innovation to contribute to the long-term competitiveness and sustainability of the sector (OECD, 2016b). Such a shift would present an opportunity to encourage an acceleration of environmental innovation to reduce water use and GHG emissions and other pollutants from the sector, and to promote ecosystem and habitat protection and restoration. While subsidy-based environmental programmes have been in place for decades (e.g. to support farmers adopting riparian buffers or efficient irrigation), environment is only now becoming a national priority considered alongside other issues facing the sector. In a 22 July 2016 statement on developing the next Agriculture Policy Framework for Canada, federal, provincial and territorial agriculture ministers identified environmental sustainability and climate change as one of the priorities.

3. Environmental expenditure and investment

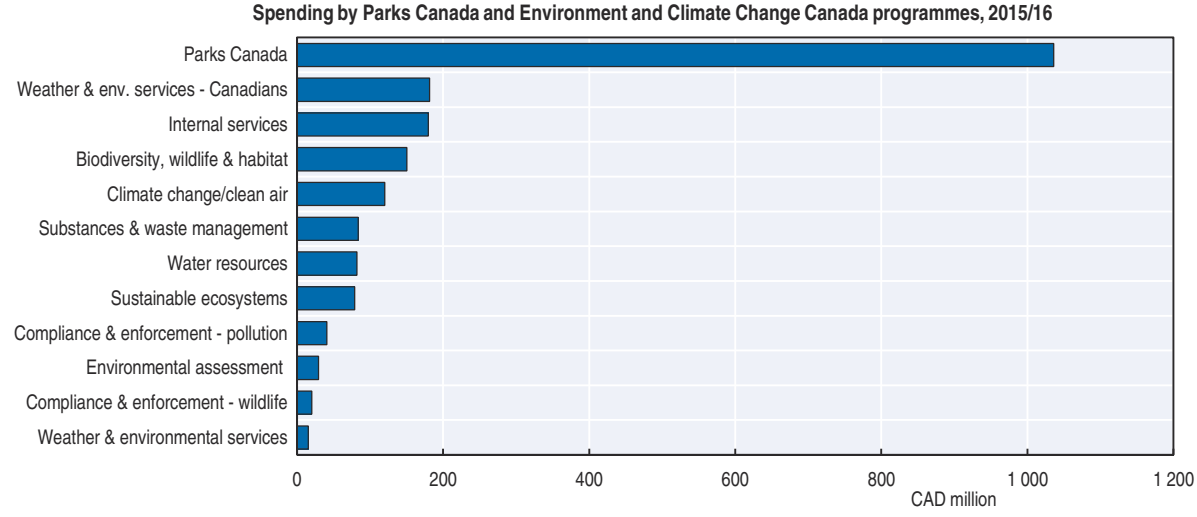
Both public and private environmental expenditures have increased in Canada over the past decade. Significant gaps, however, remain to build the environmental infrastructure for a green growth development path. Infrastructure is one of the key elements of any green growth strategy. It provides significant opportunity to improve environmental performance, boost economic growth and ensure resiliency to climate change. Canada has recently embarked on a significant infrastructure investment programme to address deteriorating assets and build new ones to support environmental, social and economic goals. This presents an opportunity to pursue a more strategic approach to project selection than in the past, and to better align project criteria and design with environmental objectives. The new Infrastructure Bank could improve co-ordination and standardisation of approaches to leveraging private sector investment for green infrastructure across Canada.

3.1. Environmental expenditures

Public expenditure

It is difficult to establish a comprehensive national picture of environmental spending in Canada, since environmental responsibilities are spread across multiple federal departments, as well as provincial and municipal governments. Indications are, however, that public spending on the environment has increased over the past decade. Overall spending by agencies under the Environment Minister's portfolio has increased by 38% since 2005 (in nominal terms). By contrast, spending on environmental protection and mitigation by Natural Resources Canada seems to have decreased since 2005 (LAC, 2005; PWGSC, 2016). Parks Canada received most resources among the agencies and programmes under the Environment Minister's portfolio, followed by weather services, internal services and biodiversity wildlife and habitat (Figure 3.7). The 2017 federal budget provided an additional CAD 405 million over five years for promoting national parks, completing the national trail system, protecting marine and freshwater ecosystems and implementing the Air Quality Management System. In addition, the budget provided CAD 650 million over five years to implement PCF-related commitments, such as phasing out coal-fired electricity and developing a clean fuel standard for buildings, transportation and industry (Finance Canada, 2017).

Figure 3.7. **Parks Canada has the largest expenditure among environmental agencies and programmes**



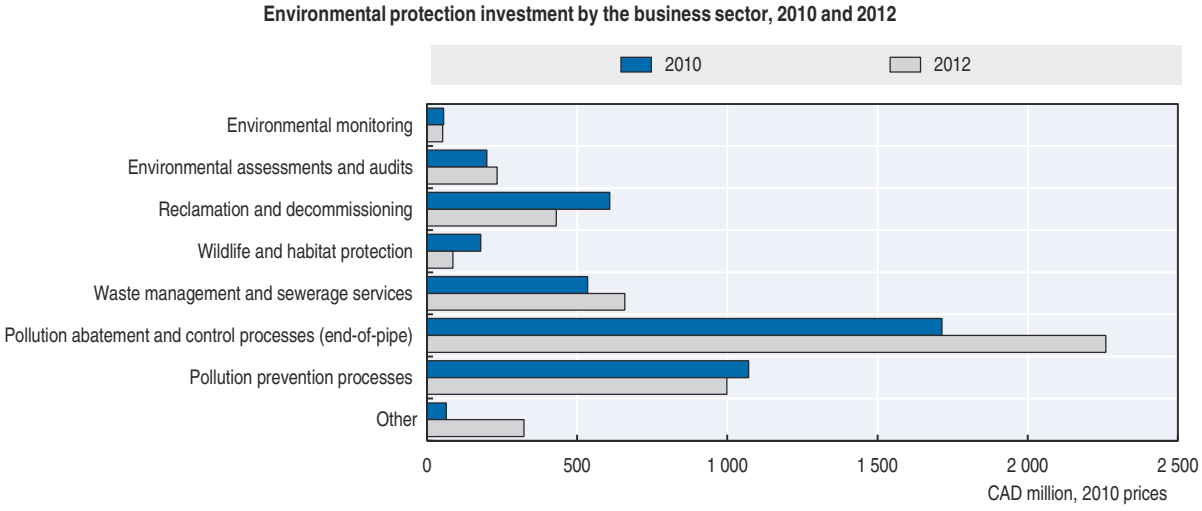
Source: PWGSC (2016), *Public Accounts of Canada 2015-16.*

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Business expenditure

Business capital expenditures related to environmental protection increased by 14% between 2010 and 2012 (in real terms). Pollution abatement, which accounts for nearly half of capital expenditure, increased by 32% over that period (Figure 3.8). Capital investments in renewable energy technologies rose 20%. Operating expenses mainly target waste management and sewerage services. Canada's oil and gas industry was responsible for 43% of total business environmental expenditures, while the mining and quarrying industry accounted for 12% (Statistics Canada, 2015a).

Figure 3.8. **Business capital spending for environmental protection focuses on pollution abatement**



Source: Statistics Canada (2017), "Table 153-0052", *CANSIM* (database).

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3.2. Investment in environment-related infrastructure

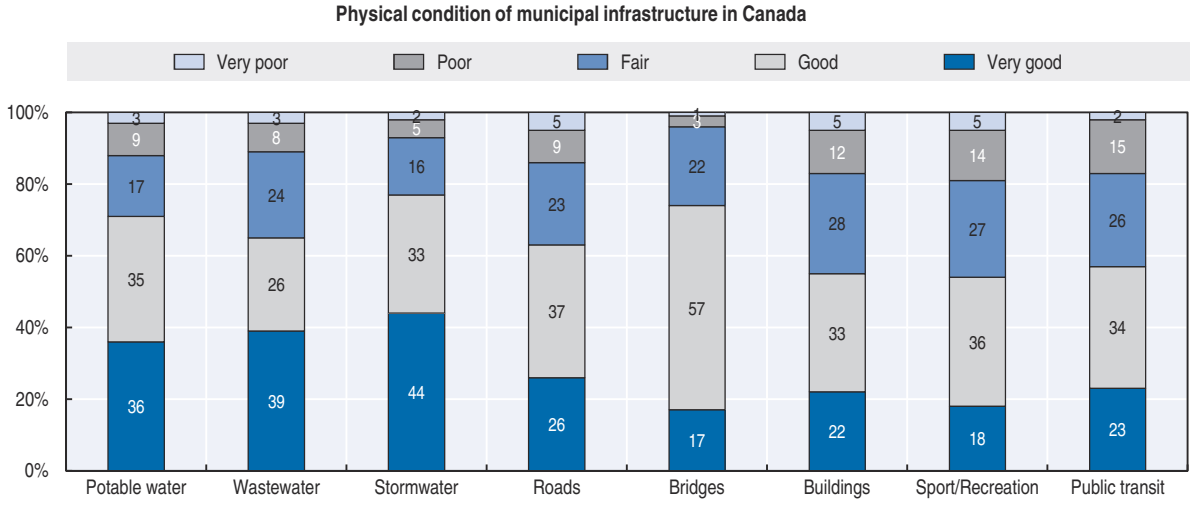
State of Canada's environmental infrastructure

The coverage and quality of Canada's infrastructure is generally good in international comparison, given its large geographic size (OECD, 2016c). However, one-third of municipal infrastructure – which represents 57% of Canada's core public infrastructure – is estimated to be in fair, poor or very poor condition (Figure 3.9). It would cost an estimated CAD 141 billion to replace infrastructure in poor or very poor condition. Moreover, reinvestment rates are too low across all infrastructure categories to avoid further deterioration. Some of the biggest gaps are in areas where careful investment can also help meet environmental goals, such as public transit, buildings, roads and wastewater. Significant investment will also be needed to support a decarbonisation of energy generation, electrification of the economy and energy efficiency improvements, which will be needed to achieve Canada's climate mitigation goals.

Renewable energy

Over 2005-14, investment in renewable energy (excluding large hydro) increased steadily from USD 1 billion to USD 5.4 billion (BNEF, 2017). Investment has dropped since, however, and Canada slipped from the top ten investing countries in 2015 (BNEF and UNEP, 2016). Wind became the predominant non-hydro renewable source, increasing from 1 567 GWh in 2005 (0.2% of total primary energy supply) to 22 538 GWh (3.4%) in 2014 (IEA, 2017b). The federal government estimates investment needs in electricity infrastructure at CAD 350 billion until 2030. An additional CAD 16 billion is needed to be consistent with a low-carbon development path (GoC, 2016b). While there is no federal target for renewable energy development, other than a commitment to phase out coal (which is expected to help Canada achieve 90% non-emitting electricity by 2030), most provinces have their own renewable targets that are helping to drive increased investment (see Chapter 4).[8] The federal government also encourages renewable development by providing higher fiscal depreciation rates within its corporate income tax regime. Ontario has a feed-in-tariff for renewable energy sources (OECD, 2017a).

Figure 3.9. **Canada has a large proportion of infrastructure in need of repair or replacement**



Source: FCM (2016), *Canadian Infrastructure Report Card: Informing the Future.*

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Transportation and electrification

Investment in inland transportation infrastructure more than doubled between 2005 and 2013. However, the deficit in transportation infrastructure is still estimated at CAD 22 billion. The deficit in transit infrastructure is estimated at CAD 23 billion, which does not take into account investments needed to address unmet current or future demand (FCM, 2016). Ontario, Quebec and British Columbia have all expanded their charging infrastructure for electric vehicles.[9] In 2016-17, the federal government announced an additional CAD 182 million to support expansion of existing, and development of next-generation, infrastructure technology. However, Canada still lags behind other countries in electric vehicle purchases. In 2015, EV plug-ins represented 0.37% of the light duty vehicle market in Canada compared with 1.3% in Europe and 18.7% in Norway (EV Volumes, 2017). In addition to encouraging the electrification of the transportation sector, sustainable transportation will also require a shift from building more roads to promoting alternatives such as public transit, bicycle- and pedestrian-friendly cities, and reducing demand for transport.

Energy efficiency

Despite improvements, Canada remains one of the most energy-intense economies in the OECD (Chapter 1). GHG mitigation policies therefore need to target the demand side of the equation, as well as large emitters. Canadian households consumed an average of 11 000 KWh of electricity per year in 2010, high in comparison to France (7 350 KWh), the United Kingdom (4 510 KWh) and Germany (5 760 KWh) (GoC, 2016b). Between 2002 and 2012, energy efficiency improvements in Canada increased GDP by about 1%, or CAD 16 billion, per year and added approximately 2.5% to overall employment (EMMC, 2014). Further investments in residential, commercial, industrial and transportation efficiency will be needed to achieve long-term decarbonisation.

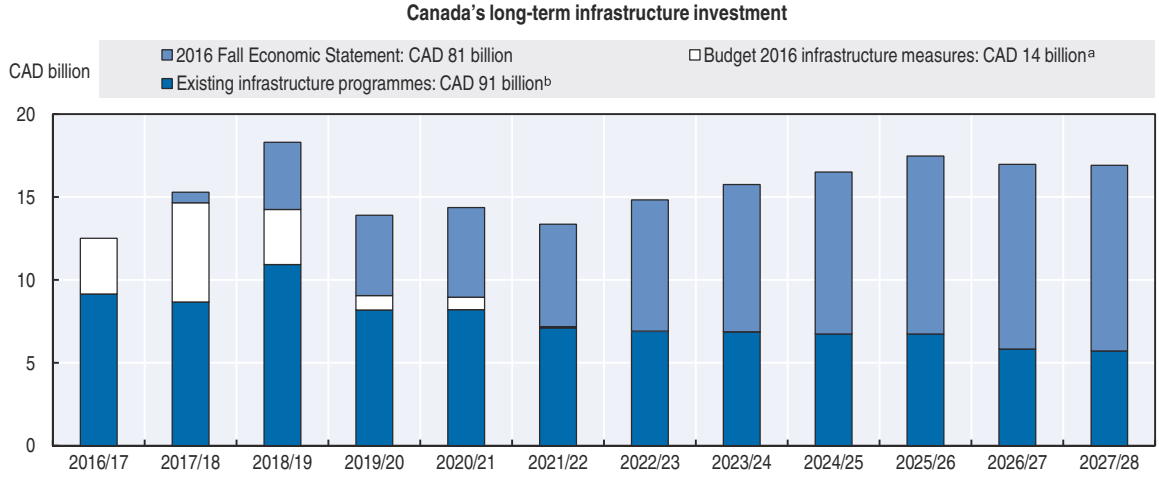
Water and wastewater

Much investment in water, wastewater and stormwater infrastructure has relied on federal funding over the past decade, largely due to lack of municipal financial capacity. The cost of replacing assets in very poor or poor condition is estimated at CAD 61 billion (FCM, 2016). In 2012, the federal government passed the Wastewater System Effluent Regulations (WSER), which require wastewater treatment facilities to meet effluent quality standards equivalent to secondary level of treatment (Chapter 5). Meeting the requirements is estimated to cost about CAD 6 billion over the next three decades (FCM, 2016). Full-cost pricing and demand management will be important to help municipalities make the necessary investment, in addition to implementing commitments made from federal and provincial governments for additional infrastructure financing.

3.3. Government infrastructure investments

Sub-national governments (i.e. provinces, territories and municipalities) account for over 95% of public infrastructure investment. The federal government has, however, been a major investor in recent years through transfers to sub-national governments, as part of an effort to address infrastructure gaps and support economic growth. In Budgets 2016 and 2017, the federal government announced more than CAD 90 billion in new funding over 12 years (building on existing infrastructure programmes of over CAD 90 billion) (Figure 3.10). This includes significant support for public transit (CAD 29 billion) and green infrastructure supporting GHG reductions, clean air and clean water (CAD 27 billion). A Low Carbon Economy Fund was also established that provides CAD 2 billion over five years to support provincial and territorial actions that reduce GHG emissions (Finance Canada, 2016a, 2017). Other federal infrastructure investments also have an environmental dimension.[10]

Figure 3.10. **Canada's long-term infrastructure plan will help provide stable funding**



a) Includes Phase 1 (CAD 11.9 billion) strategic investments in post-secondary infrastructure (CAD 2 billlion) and rural broadband (CAD 500 million).
b) Includes Infrastructure Canada programmes, Indigenous infrastructure programmes and social infrastructure programmes.
Source: Finance Canada (2017 and 2016), Budget 2017 and Fall Economic Statement 2016 websites.

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While funding has increased substantially, Canadian federal, provincial, territorial and municipal governments have not always followed a strategic, co-ordinated and comprehensive approach to project selection and design. Projects have traditionally been selected through

a bottom-up process where municipalities identify priority, shovel-ready projects that line up with provincial or federal funding envelopes. There has been limited strategic thinking at the national or regional level in terms of projects that best align with multiple economic, environmental and social priorities. There has also been limited exploration of innovative approaches, such as the use of natural infrastructure in place of, or as a complement to, grey infrastructure. The federal government plans to taking a more outcomes-based approach to infrastructure funding for future funding announced under the Investing in Canada Plan in the federal Budgets of 2016 and 2017.

The Federation of Canadian Municipalities (FCM) has proposed greater alignment of transit, green and social infrastructure components of federal funding. This would allow more flexibility in stacking different pools of funding to move key projects forward and the inclusion of projects such as wetland acquisition and preservation as climate-resilient infrastructure. Greater alignment and flexibility could encourage innovative projects that achieve multiple objectives, such as energy-efficient social housing or greening of public transit systems (FCM, 2017). To that end, Canada could draw on approaches from other OECD member countries. Australia, for example, develops a national priority list of infrastructure projects that have strategic merit to help governments make integrated decisions (IA, 2017). Working with provinces, territories and municipalities to develop a pipeline of bankable projects and delivery models attractive to private investors would also help improve the efficiency and effectiveness of public funding. The data initiative on Canadian infrastructure announced in the 2017 federal budget will be a helpful starting point to better decision making.

In addition, there could be clearer guidance on project criteria and design across all infrastructure projects, considering multiple environmental objectives, including climate change adaptation and biodiversity conservation. In 2016, the House of Commons approved a private member's motion to require all projects receiving over CAD 500 000 in federal funding to analyse their impact on GHG emissions. Proposed projects should also give priority to climate change mitigation where appropriate (Parl, 2016). In May 2017, the Minister of Infrastructure and Communities publicly announced that local, provincial and territorial governments would apply a "green lens" on proposed infrastructure projects, focusing in particular on GHG emission reductions and enhanced climate resilience to reduce the cost of severe weather on communities. Details on specific criteria and methodology for implementing these requirements have not yet been announced. Potential considerations include, for example, what impact a "green lens" or the analysis of GHG emissions may have on project design or decision making, how it will relate to existing environmental impact assessment and strategic environmental assessment requirements, and where it is appropriate to give priority funding to certain projects.

3.4. Leveraging private sector investment

Canada's use of public-private partnerships has increased substantially over the past decade. Prior to 2000, they were used almost exclusively in the health and transportation sector, but have since shifted to water and wastewater, as well as airports and solid waste disposal. The federal government created PPP Canada in 2008 to help finance deals at the federal, provincial and municipal levels. It is now seeking to develop additional opportunities to leverage private sector capital. A key mechanism will be the newly created Canada Infrastructure Bank (Box 3.2).

Canada is increasingly using green bonds, which have been issued by the governments of Ontario and Quebec, TD Bank and Telus/Westbank, and Export Development Canada.[11]

The total Canadian green bond market was CAD 2.9 billion for bonds labelled green and another estimated CAD 30 billion for climate-aligned investments (such as hydroelectricity) (CBI, HSBC and SP, 2016). The new Infrastructure Bank could play a role in consolidating or co-ordinating green bonds in Canada. This could help establish common standards and definitions, encouraging a larger pool of bankable projects.

Box 3.2. **Canada seeks to leverage private capital through new Canada Infrastructure Bank**

Seeking to multiply its infrastructure investments by attracting private capital, the government of Canada is creating a Canada Infrastructure Bank. The Bank would use federal support to attract private sector and institutional investment to new revenue-generating infrastructure projects that are in the public interest. It would provide an additional option for federal, provincial, territorial and municipal project sponsors to advance projects that could be suitable candidates for revenue generation. It will operate at "arm's-length" from the government, meaning that day to day decisions will not require government approval. However, it will remain accountable for the allocation of funding. The concept of the Bank arose from recommendations by the Advisory Council on Economic Growth, appointed by Canada's Finance Minister.

The Canada Infrastructure Bank will invest at least CAD 35 billion in large infrastructure projects using a wide range of financial instruments, including debt and equity. Of this amount, CAD 15 billion is sourced from announced infrastructure funding. The remaining CAD 20 billion will be for investments where the Bank will hold assets in the form of equity or debt. The 2017 federal budget committed to invest at least CAD 5 billion each in public transit and green infrastructure.

The advantage of having one organisation focused on leveraging private sector capital is that it can provide a single point of contact for private investors, develop a hub of skills and expertise that would be difficult to replicate across multiple organisations, and more effectively structure, negotiate and implement infrastructure projects that are attractive investment opportunities.

Source: ACEG (2016); Finance Canada (2016a).

4. Promoting eco-innovation and green markets

Although Canada has a relatively strong innovation framework, the pace of eco-innovation has been slow relative to leading OECD member countries. Canada's share of the global clean technology market shrank from 2.2% to 1.3% over 2005-14 (AA, 2016). One key barrier to accelerated growth has been limited domestic demand for eco-innovations. Clean technology firms also find it difficult to obtain the financing they need to grow. Carbon pricing and new procurement policies will help boost demand for eco-innovations in Canada, while a new emphasis on public investment in research and development (R&D) and skills development should help increase supply.

4.1. Eco-innovation

Overall innovation performance and policy

Canada's innovation framework benefits from a good skills foundation, a high-quality university-centred research system and one of the world's most generous R&D tax regimes. However, gross domestic expenditure is low compared to the OECD average (see Basic

Statistics) and in decline (OECD, 2016d). Several major firms perform well in terms of R&D investment, but overall business investment is low, particularly among small and medium-sized enterprises (SMEs). The link between scientific research and commercialisation and business is often weak. Shifting from R&D tax credits towards competitive and transparent grants, which are better suited to the needs of young firms, could be one way to foster co-operation in innovation (Jenkins, 2011; OECD, 2015). The federal government has started to move in this direction. Its 2012 budget reduced the rate for refundable investment tax credits from 20% to 15% (Finance Canada, 2012). In March 2017, the government announced the Innovation and Skills Plan, which makes a number of commitments across six key focus areas, including clean technology, to foster growth and create jobs.[12]

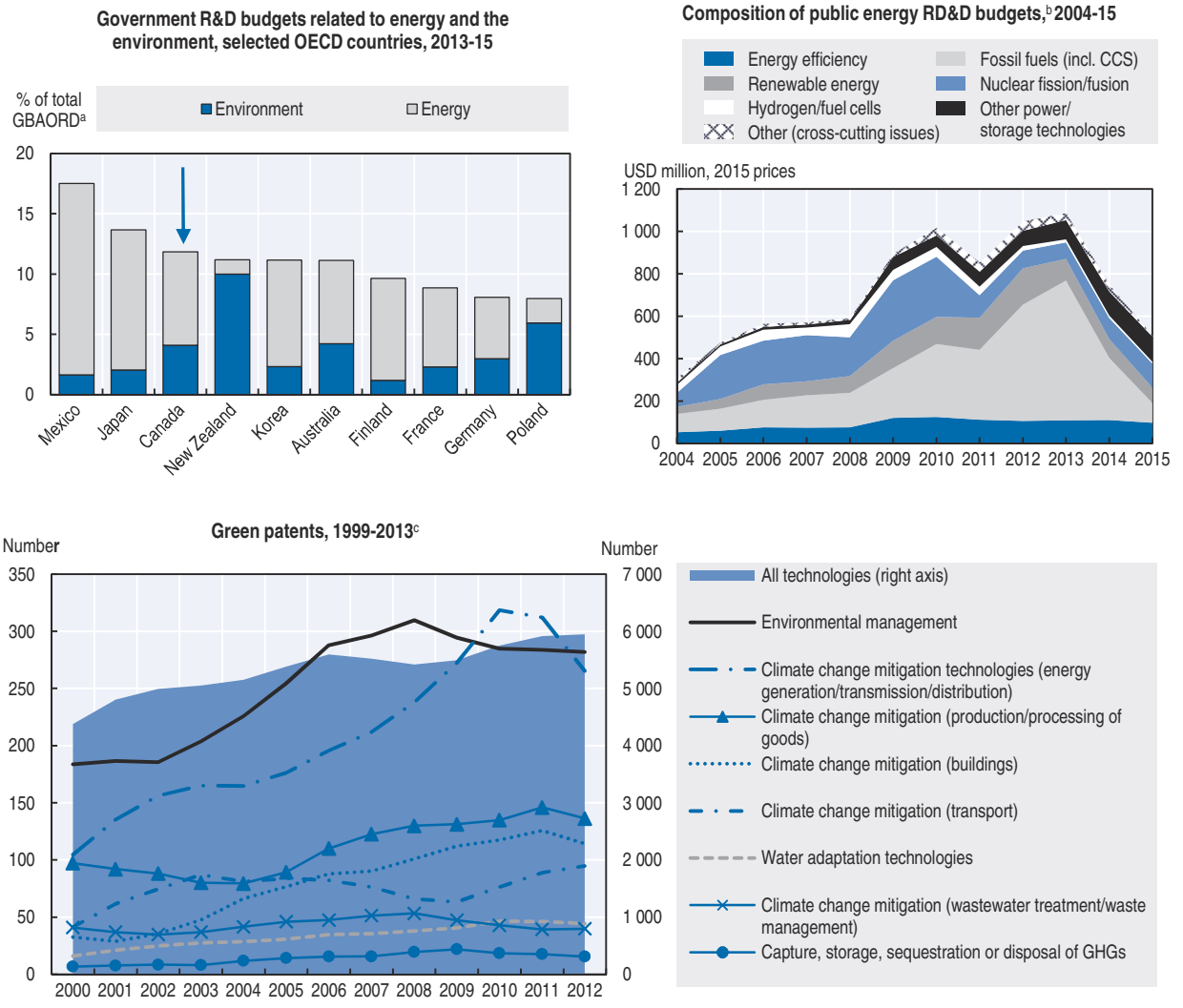
Performance of eco-innovation

Governments are the main source of funding for environmentally related research in Canada. Environment-related R&D accounts for about 4% of total government R&D outlays, in line with the OECD average. Nearly 8% of government R&D outlays target the energy sector, which is high compared to most other OECD member countries (Figure 3.11). The large majority of energy-related R&D targets fossil fuel energy. This reflects major investment in carbon capture and storage (CCS) projects (Chapter 4) as well as in research aimed at mitigating the environmental impacts of oil and gas extraction. Support for renewable energy and energy efficiency has increased slightly since 2004, but it remains one of the lowest in the OECD as a percentage of total public energy R&D.

Private sector involvement in environmental R&D has generally been limited to date. However, some innovative collaborative projects could serve as a model for further expansion. The Canadian Oil Sands Innovation Alliance (COSIA), for example, brings together oil sands producers focused on accelerating the pace of improvement in environmental performance (Box 3.3). The Bio-pathways Partnership Network for Canada's forestry sector provides a forum for member companies to partner on initiatives of common benefit. Together, they collaborate to further the use of wood fibre to produce bio-chemicals, bioenergy, and bio-materials (FPAC, 2016). The federal government, in partnership with provinces and territories, could play a convening role and potentially offer some financial contribution to encourage other sectors of the economy – such as freight transport and chemicals – to undertake similar collaborative approaches, potentially involving academia as well. This would be one way to increase private sector engagement in important eco-innovation challenges.

The number of patent applications in environmentally related technologies originating from Canada increased since the turn of the century. The rate of increase, however, was not as fast as in the United States, Korea, Japan, Germany, France and the United Kingdom (OECD, 2017b). In 2013, about 10% of Canada's patent applications were related to the environment, similar to the OECD average. Environmental-related patents per capita are below the OECD average. The greatest growth occurred in patents for environmental management technologies (particularly related to water and wastewater treatment and oil spill clean-up) and energy-related climate change mitigation technologies (Figure 3.11). Canada has been a leader in water and wastewater technologies for a number of years. However, companies are now also emerging in energy efficiency, energy storage, smart grid, green concrete, precision agriculture, plastic recycling and mine sustainability (CTG, 2017).

Figure 3.11. **A high share of public R&D spending targets the energy sector**



a) Government budget appropriations or outlays for R&D.
b) Data refer to fiscal year. Government and state-owned enterprises from 18 federal departments and agencies, as well as provincial and territorial governments funding energy RD&D related activities with the exception of municipalities.
c) Three-year moving average data. Patent statistics are taken from the Worldwide Patent Statistical Database (PATSTAT) of the European Patent Office (EPO), with algorithms developed by the OECD. Data refer to patent applications filed in the inventor's country of residence according to the priority date and apply solely to inventions of high potential commercial value for which protection has been sought in at least two jurisdictions.
Source: IEA (2016), *Energy Technology RD&D Budgets* (database); OECD (2017), *Government Budget Appropriations or Outlays for R&D* (database); OECD (2017), "Patents", *OECD Environment Statistics* (database).

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Eco-innovation policy

Canada's federal government recently announced a significant increase in public funding to foster eco-innovation and clean technology development. As part of the global Mission Innovation initiative, Canada committed to double investments in clean energy research, development and demonstration (RD&D) by 2020 from 2015 levels.[13] The increase will be supported by investments in the new Innovation and Skills Plan, as well as commitments under the PCF to build early stage innovation for clean technology and accelerate their commercialisation and diffusion (GoC, 2016a). The 2017 budget committed to CAD 1.4 billion to support clean technology producers with new equity financing, working capital and project

Box 3.3. **Canadian oil sands innovation alliance pools private capital to support R&D**

Growing public and international concern about the environmental performance of Canada's oil sands sector led stakeholders to recognise their collective interest in improving the environmental performance of all oil sands facilities. In 2012, the private Canadian Oil Sands Innovation Alliance (COSIA) was established to capture, develop and share the most innovative approaches and best thinking to improve environmental performance in the sector. Since its inception, COSIA member companies have shared 936 technologies and other innovations that cost almost USD 1.33 billion to develop. This required a significant cultural shift from competition to collaboration.

COSIA consists of 13 founding oil sands producing companies, and more than 30 associate members. These include potential innovation suppliers or partners such as General Electric, IBM and Lockheed Martin, as well as the University of Alberta and organisations such as the National Research Council. COSIA acts as a potential source of financing for smaller innovators. It issues challenges for any company to submit ideas for solutions to specific environmental priorities. The organisation has four environmental priority areas: tailings, water, land and GHG emissions.

Source: COSIA (2016).

financing, in addition to creating specific initiatives. The new Impact Canada Fund, for example, aims to tackle "big challenges" in Canada such as reducing the reliance of remote communities on diesel fuel and developing smart cities (Finance Canada, 2017).

The financial boost can be expected to stimulate eco-innovation and clean technology supply. However, the various federal, provincial and territorial organisations involved in supporting clean technology innovation may also need to co-ordinate their activities more effectively. To achieve this, the federal government proposed establishing the Clean Growth Hub as part of broader efforts to streamline innovation support mechanisms under the newly-established Innovation Canada single-window platform. The hub would bring together key federal departments and partners that support clean technology innovation to simplify client services, improve programme co-ordination and enable monitoring and reporting on results. In addition, a working group with representation at the federal-provincial-territorial levels has been established under the PCF to support co-ordination and implementation of clean technology commitments across the country. This will help reduce overlap and identify gaps. Innovation programmes should be accessible to all technology fields relevant for the green growth transition, including energy efficiency, the circular economy and product innovation. There also seems to be a need for public support institutions to tolerate greater risks.

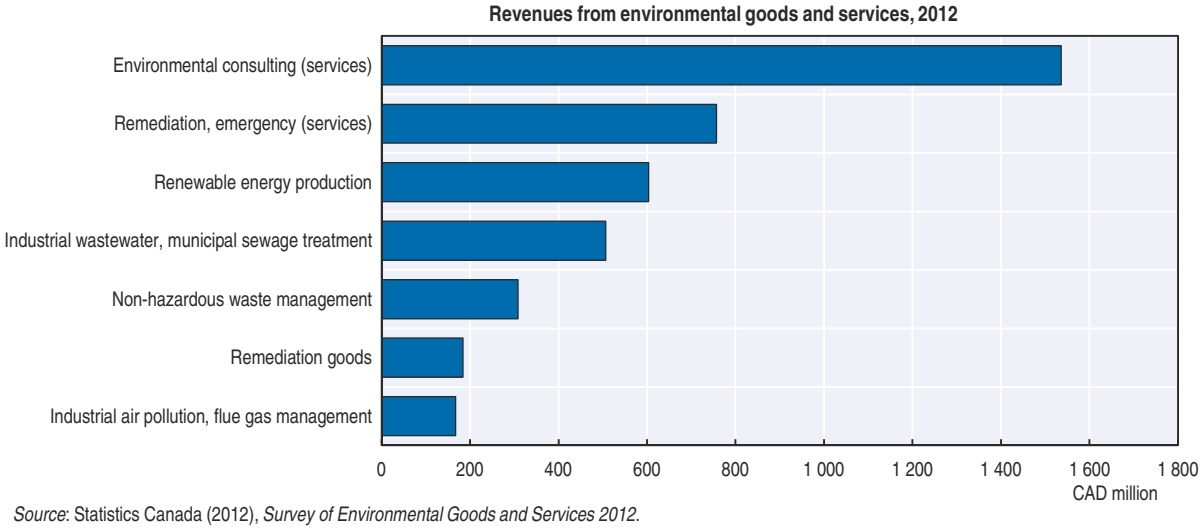
The introduction of Canada-wide carbon pricing, and greater use of labelling and procurement policies, will boost demand for eco-innovation and clean technologies. In a welcome step, the federal government has committed to reform procurement practices to align with green objectives and to encourage federal departments to act as test-beds for late-stage green innovations (ECCC, 2016a).[14] As well, it has put a new focus on greening government operations, committing to reduce GHG emissions from federal buildings and vehicle fleets by 40% below 2005 levels by 2030. The Centre for Greening Government tracks government GHG emissions and co-ordinates efforts across government. Green procurement initiatives at the provincial, territorial and municipal level are at various stages of evolution.

Overall, however, provincial governments could make better use of procurement. This would ensure that firms have strong domestic demand for clean technologies and products. Labelling programmes include the ENERGY STAR for consumer products in the top 15% to 30% of their class for energy performance, and the EnerGuide Rating System for homes (NRCan, 2015).

4.2. Markets for environmental goods and services

According to a survey conducted by Statistics Canada, business revenues related to the sales of environmental goods and services (EGSs) reached CAD 4.1 billion in 2012, with goods accounting for 44% and services accounting for 56%. Environmental consulting services accounts for most revenue, followed by remediation and emergency services, and goods related to renewable energy production and wastewater treatment (Figure 3.12). While revenue from environmental services grew 33% between 2010 and 2012, revenue from environmental goods fell by 19%. EGS businesses have exports worth CAD 748 million, mainly to the US market (Statistics Canada, 2015b).

Figure 3.12. **Canada receives more revenue from environmental services than from goods**



Source: Statistics Canada (2012), *Survey of Environmental Goods and Services 2012*.

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The survey is limited in scope and coverage, with a narrow sub-set of technologies and sectors. In particular, it does not include small businesses (it only captures businesses with a minimum revenue of CAD 750 000). The actual size of Canada's EGS sector is thus likely to be larger. While not directly comparable, an analysis of Canada's "clean technology industry" that includes SMEs estimated revenues at CAD 13.3 billion in 2015, with exports of CAD 6.7 billion and employment of 55 200 people (AA, 2017). In 2016, the federal government committed to expand the Statistics Canada survey on EGS to a broader range of technologies. Statistics Canada will also define Canada's clean technology sector, establish a 2015 baseline on the industry by 2018 and track the contribution of the sector to GDP and employment (ECCC, 2016a). The 2017 federal budget provided CAD 14.5 million over four years for the development of a clean technology data strategy.

Canadian clean technology companies face challenges in obtaining financing for commercialisation and growth to scale of environmentally related inventions. This is due

to a variety of reasons, such as company size, perceived technology risk, capital intensity, lack of investor knowledge and length of time to pay out (AA, 2016; CCTL, 2016). Clean technology continues to receive lower levels of venture capital investment than other sectors such as information communications technology (ICT) and Life Sciences. The lack of demand for clean technologies in Canada has also been a challenge for eco-innovation. Green technologies have much lower adoption rates by Canadian companies than other technologies. Cost, lack of relevance, lack of regulatory pressure and lack of knowledge have been identified as key barriers (WGCTIJ, 2016).

5. The social consequences of the transition towards green growth

Transitioning towards green growth can have both positive and negative impacts on society. The challenge for governments is to implement policies that help businesses and individuals capture opportunities, provide support for those most affected by environmental damage and minimise negative impacts on vulnerable households or businesses. Canada lacks a co-ordinated and consistent approach across governments towards green growth, but there is movement towards the types of policies needed. These include well-designed carbon pricing systems, support for Indigenous community adaptation to climate change and the skills element of the federal Innovation and Skills Plan. However, there is scope to expand the involvement of Indigenous communities in green growth. Green skills needs could be more systematically integrated into skills and training policies across federal and provincial governments.

5.1. *Distributional impacts of environmental policies*

Most provincial carbon pricing policies have mechanisms to minimise the impacts on vulnerable households and businesses (Table 3.1). Quebec chose to link its cap-and-trade system to California to lower the carbon price and costs faced by households and businesses, while also allocating free allowances to industrial emitters. British Columbia, on the other hand, used its carbon tax revenue to reduce corporate and personal income taxes. Ontario and Quebec use parts of the revenue from their cap-and-trade system to fund programmes encouraging the uptake of electric vehicles, expanding public transit, or increasing the energy efficiency in buildings, for example. Alberta's new carbon levy includes a rebate for low- and middle-income households; its policy for large industrial emitters is expected to incentivise emission reductions, while helping protect competitiveness (Box 3.4). Alberta has also agreed to compensate coal-fired power producers that will need to shut down before the end of their useful life to meet the government's commitment to phase out coal-fired power by 2030.

While it makes sense to introduce rebates or other measures to minimise the impact on low-income households, providing everyone with rebates or limited price increases can dilute price signals that encourage more environmentally-friendly behaviour and purchasing decisions. Similarly, while it is important to address competitiveness risks, support should target trade-exposed sectors for which no effective abatement technologies are available, preserve the price signal and be transitional rather than permanent. For example, a 2014 study found no compelling evidence to justify the exemption for agriculture from British Columbia's carbon tax (Rivers and Schaufele, 2014). The economic benefits of using tax or auction revenue to reduce corporate and personal income taxes should also be considered.

Table 3.1. **Mechanisms used to address distributional impacts from carbon pricing by province**

Province	Instrument	Estimated impacts	Mechanisms to address
Quebec	Cap-and-trade	**Households:** costs below 2.3% of household income **Industry:** costs below 4% of industry contribution to GDP, but potentially greater impact on aluminium sector	• linking to California to lower price • free allowances for industrial emitters (reduced annually by 1% to 2%) • stability reserve that acts as a price ceiling, offsets as compliance option • use of auction revenue for transit, home energy retrofits, company energy efficiency programmes and clean technology.
British Columbia	Carbon tax (currently frozen at CAD 30/tonne)	**Households:** tax shown to be progressive, with negative impact on below-median income households smaller than above-median income households. **Economy:** Per capita GDP growth outpaced other Canadian provinces between 2008 and 2013.	• revenue-neutral carbon tax with revenue recycled to reduce personal and corporate income taxes • personal tax measures aimed at low-income households • exemptions for agricultural subsectors • no increases in carbon tax in 2013-18.
Alberta	Carbon levy (CAD 20/tonne in 2017, CAD 30/tonne in 2018) and carbon competitiveness regulation	**Households:** additional CAD 6 to CAD 8.75 per month, petrol prices increase by about 6.7 cents per litre, natural gas prices by 1.50 cents per Gj, likely increase in electricity prices of less than 2 cents per kWh. **Business:** reduced average cost compared with tax at same price. Most oil sands firms will face costs of less than CAD 1 per barrel.	• carbon rebates to lower and middle-income Albertans (6 in 10 households) • Alberta's small business corporate income tax rate reduced from 3% to 2% • exemptions for fuel used in industrial processes, by First Nations, by farmers, by inter-jurisdictional flights and fuel sold for export, as well as for biofuels • transition to product- and sector-based performance standard for large industrial emitters at the end of 2017, with a price of CAD 30/tonne and rebates tied to output-based allocations of emissions rights.
Ontario	Cap-and-trade	**Households:** additional cost of CAD 13 per month (CAD 5 for residence and CAD 8 for driving) in 2017. **Businesses:** reduced investment for large industrial emitters and manufacturing, but overall increase in investment across the economy of (0.06% in 2020). **Energy prices:** increase in natural gas prices of 3.3 cents/m^3; propane 4 cents/m^3; petrol 4.3 cents/litre; diesel 5 cents/litre; electricity prices stable.	• linking with Quebec and California cap-and-trade to lower carbon price and costs • preventing any net increase in electricity prices as a result of cap-and-trade • introducing an electricity rebate for eligible low-income consumers, small businesses and farms • transitional free allowances to large industrial emitters • investing auction revenue in new technologies and processes that will help businesses and households reduce emissions.

Source: Elgie and McClay (2013); Barrington-Leigh et al. (2014); Rivers and Schaufele (2014); Beck et al. (2015); Tombe (2015); GoO (2016); MDDELCC (2016); Sawyer and Peters (2016).

Box 3.4. **Alberta is designing carbon pricing to avoid competitive risks**

The Canadian province of Alberta has higher, and faster growing, GHG emissions than any other province or territory. This is largely a result of its oil and gas sector, and particularly the extraction of oil sands. A relatively large proportion of Alberta's economy (18%) is emissions-intensive and trade-exposed. This creates a risk that business activity moves to other jurisdictions (many of which have less ambitious climate policy). At the same time, the drop in oil prices since 2014 has had a significant impact on the province's economy, with delays and cancellations of oil and gas projects, rising unemployment and decreasing government revenue.

In this challenging context, the province has become one of the first fossil-fuel based economies in the world to implement ambitious carbon pricing. The province uses a hybrid system that combines an economy-wide carbon price of CAD 20 per tonne of CO_2 as of 2017

Box 3.4. **Alberta is designing carbon pricing to avoid competitive risks** *(cont.)*

(set to rise to CAD 30 in 2018) with a trading scheme for large emitters. Alberta's Climate Leadership Plan, supported by an expert Climate Leadership Panel, concluded that climate policy is in fact consistent with long-term competitiveness in Alberta's oil and gas sector. It reasoned that climate policy encourages innovation to reduce costs through reduced input fuels, increased efficiency and reduced fugitive losses. For industrial sectors, the panel recommended replacing the existing GHG regulation that expires at the end of 2017 with what it calls a Carbon Competitiveness Regulation (CCR). Under the existing approach, industrial facilities above an emissions threshold must reduce emissions intensity by 20% below an established historical per-barrel facility-specific benchmark in 2017, paying USD 30 per tonne for emissions that exceed the standard (or purchasing offsets or emission credits). This approach meant that companies were only paying for a portion of their emissions, and it penalised good performers with low facility-specific benchmarks. The panel's proposed new approach, which is expected to be adopted, would price all emissions from industrial facilities (with the price increasing at 2% above inflation each year). Further, the benchmark would be sector-wide, improving incentives for good performers.

The panel's proposed sector-specific, output-based allocations of emissions rights help protect competitiveness. They do this by reducing the average cost for firms and considering each sector's ability to reduce emissions and the degree of international competition. Facilities that perform above the benchmark for their sector would actually be better off as a result of the policy. The rest will pay more than what they receive back. The approach creates a strong incentive to improve emissions intensity, without imposing a significant financial burden that could impact the province's attractiveness for new investment. The panel also recommended decreasing allocations by 1% to 2% per year to reflect expected improvements in energy efficiency.

Source: CLP (2015).

5.2. Capturing opportunities through skills development

Until recently, Canada has not linked green skills needs with its broader skills policy agenda. There are generally three main skills requirements to support green growth transition: upgrading skills and adjusting qualifications across occupations and industries; creating occupations from emerging economic activities; and retraining workers impacted by structural changes. Addressing these requirements does not necessarily demand new skills policies. Rather, it calls for an integration of green skills needs into broader training and skills development (OECD/Cedefop, 2014).

The new federal Innovation and Skills Plan creates a significant opportunity to integrate skills needs particular to the green growth transition into Canada's broader skills development agenda. The plan could also help Canada better link its skills development efforts to needs for clean tech development and innovation. Canada faces the general challenge that education systems and choices are not always well-linked to labour market needs (OECD, 2016c). Clean tech SMEs face skills gaps in sales, marketing, business development, product management and financial management (WGCTIJ, 2016). There is also a shortage of clean tech investor expertise needed to evaluate and identify high-potential projects. Additionally, there is a broader need to integrate green skills into post-secondary

education. The working group recommended labour market, employment and skills ministers to explore the development of "clean growth talent plans" to help guide policy development (WGCTIJ, 2016). Green talent plans should include an analysis of the skills needed at all levels, from construction workers installing energy-efficient equipment to clean technology entrepreneurs and business programmes.

5.3. Indigenous communities and green growth

Indigenous peoples are particularly important to a successful green growth transition. They are disproportionately impacted by environmental degradation, given their population in northern and remote regions, their dependence on the environment for livelihoods and culture, and their lower ability to invest in climate change adaptation or emergency response measures (CIER, 2006). At the same time, Canada's Indigenous peoples play a significant role in protecting Canada's environment, given their special relationship with nature.

Included in the 2016-19 FSDS is a commitment to work with Canadians, other levels of government, Indigenous communities and stakeholders to develop local and provincial and territorial climate change adaptation plans, while continuing to develop the Adaptation Platform and the Northern Adaptation Strategy (ECCC, 2016a). The PCF aims to reduce the reliance of Indigenous, northern and remote communities on diesel for heat and electricity generation. It seeks to develop more stringent building standards for Indigenous communities and increase support to address Indigenous health impacts of climate change. It also targets improved climate change monitoring and support for adaptation in Indigenous communities (GoC, 2016a). Fulfilling these commitments in a timely manner will be important to demonstrate that the green growth transition has tangible benefits for its most vulnerable populations. There are encouraging examples of income and employment opportunities for Indigenous communities, such as in the area of renewable power generation and in protected areas management (Box 3.5). In addition, Health Canada's Climate Change and Health Adaptation Program is supporting First Nations and Inuit communities to develop tools and skills necessary to develop adaptation plans to minimise health impacts and seize green growth opportunities.

Canada's Indigenous peoples have a growing voice in opposition to developments that carry risks of environmental damage. Mining, oil and gas, and electricity development increasingly encroaches on the traditional lands of Indigenous peoples, creating concerns about both environmental and social impacts, as well as interest in job opportunities and income. In 2012, over 600 resource projects worth more than USD 650 billion were either under construction or planned within ten years; many are within a 100 km radius of Indigenous communities (Marketwire, 2012). Governments have a legal duty to consult and Canada now endorses the UN Declaration on the Rights of Indigenous Peoples (UNDRIP). The Prime Minister has committed to a renewed, nation-to-nation relationship with Indigenous peoples, based on the recognition of rights, respect, co-operation and partnership. Uncertainty – and the potential for conflict – remains, however, in relation to the interpretation of the requirement for free, prior and informed consent (Chapter 2).

Box 3.5. **Canada's First Nations expanding green opportunities**

Renewable energy: In Northern Ontario, the Henvey Inlet First Nation has partnered with a private developer on a 300-megawatt wind farm. The project (under federal and provincial review at the time of writing) is expected to earn around CAD 10 million per year for the 900-member community as a result of a 50% equity stake in the project. Funding will be used for health, education and improved infrastructure, helping to improve quality of life in the small community. The project is also expected to provide an average of 300 jobs during construction, as well as 20 direct permanent jobs during operation. Provincial price incentives have played a key role in attracting private interest. These include Ontario's feed-in-tariff for renewable energy and an "adder" for Indigenous participation that increases with the proportion of involvement.

Protected area management: On 1 April 2017, the Ahousaht First Nation took over management of Maquinna Provincial Park near Tofino, British Columbia, as part of an agreement with the provincial government. The management plan foresees the creation of between 15 to 20 jobs for the Ahousaht community associated with tourist activities at hot springs located within the park. The First Nations chiefs in the area are interested in extending the approach to the entire Clayoquot Sound region, helping them to diversify the economy, increase local employment and improve the connection of people to the land.

Source: GE (2014); Henvey Inlet Wind (2016); Hudson (2017).

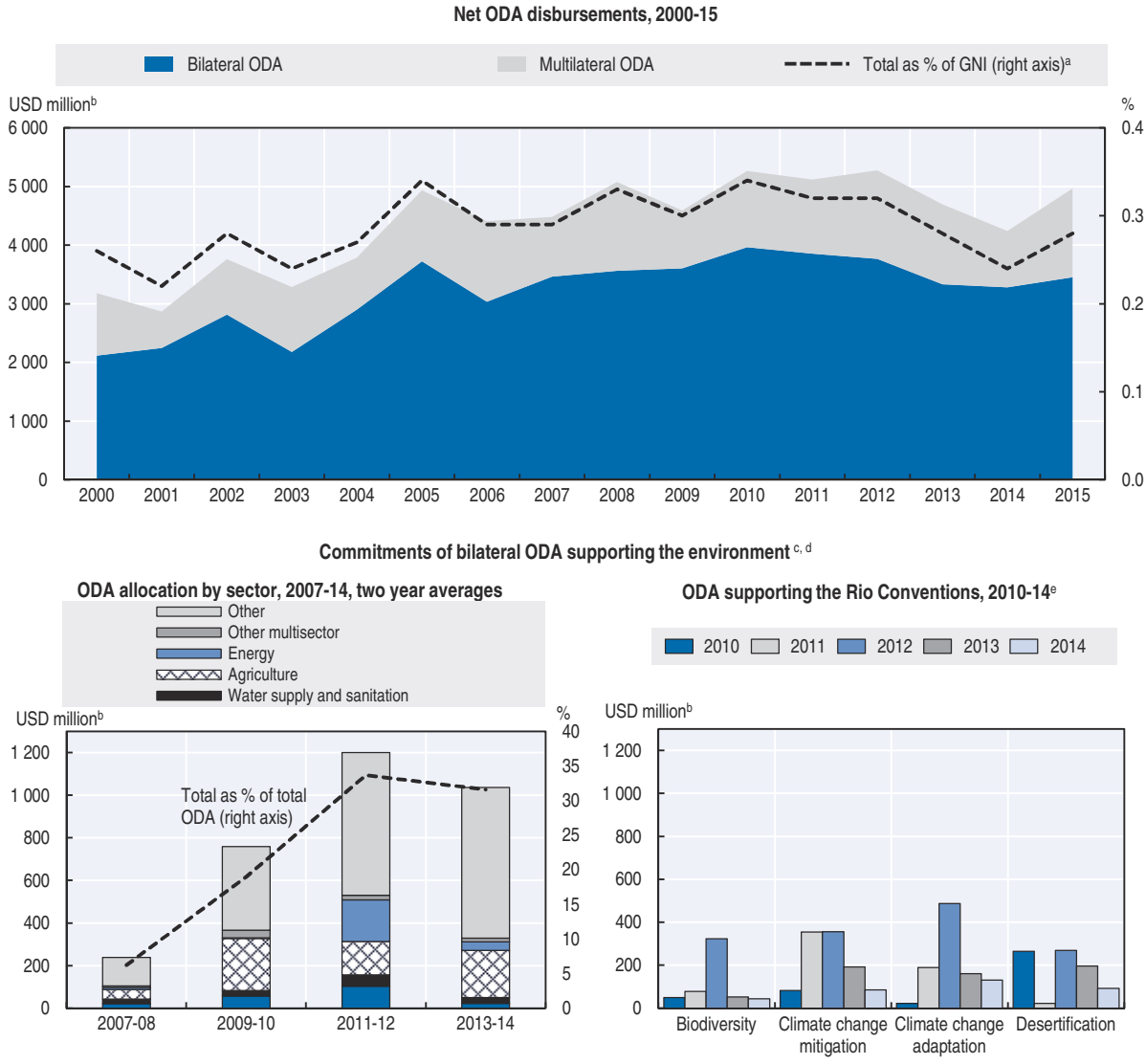
6. The international dimension of green growth: Environment, trade and development

The international dimension of green growth is particularly important for Canada. International environmental agreements have helped drive domestic environmental action. Trade dynamics – particularly in relation to the United States – have shaped environmental regulation and discussions on climate policy. Canada has retreated from two major environmental agreements since 2004 – the Kyoto Protocol and the UN Convention to Combat Desertification. However, the renewed commitment by the government elected in 2015 to engage with and implement multilateral environmental agreements is encouraging. Canada developed a federal plan to meet its commitment under the Paris Agreement, committed to meet the 2020 Aichi target related to protected areas and re-joined the UN Convention to Combat Desertification. The country is also playing an important role in international forums like the Climate and Clean Air Coalition, the Arctic Council Task Force on Black Carbon and Methane, the Global Methane Initiative and the Carbon Pricing Leadership Coalition.

6.1. Development co-operation

Canada's overall official development assistance (ODA) increased between 2004 and 2010. However, it has since declined, falling further below the average country effort of peers in the OECD Development Assistance Committee (DAC) (OECD, 2016c). Still, Canada has significantly increased the proportion of ODA that is environmentally related – from 6.2% to 31.6% between 2007/08 and 2013/14 (Figure 3.13). Some of this increase is due to climate finance and commitments leading up to Rio +20; some to better reporting and attention paid to the Rio markers. In 2015, Canada announced new climate financing of CAD 2.65 billion over five years (GoC, 2016c). The creation of the new Development Finance Institution in Canada to support sustainable development and poverty reduction in developing countries offers the opportunity to further boost environmentally related financing.

Figure 3.13. **The proportion of environmentally related ODA has increased**



a) Gross national income.
b) At 2014 prices.
c) Data refer to activities that have been marked with at least one of the environment and/or Rio policy markers. They include activities where the environment, climate change mitigation, climate change adaptation, biodiversity and/or desertification is an explicit objective of the activity and fundamental in its design, and activities where one or more of these is an important, but secondary, objective of the activity.
d) The marker data do not allow exact quantification of amounts allocated or spent in support of the environment. They give an indication of such aid flows and describe the extent to which donors address these objectives in their aid programmes.
e) An activity can target the objective of more than one of the conventions, thus respective ODA flows should not be added.
Source: OECD (2016), *OECD International Development Statistics* (database); OECD calculations.

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Since 2004, the government of Canada has taken steps to better mainstream environmental considerations into development co-operation through its Environmental Integration Process.[15] Global Affairs Canada has incorporated environmental sustainability as a cross-cutting theme to be integrated into all of Canada's international development programmes and policies. Reporting on mainstreaming has improved with the implementation of the Rio markers system. Canada assesses all of its development assistance activities for potential environmental sustainability risks and opportunities,

particularly in relation to climate change, land degradation, access to clean water and sanitation, and urbanisation. For example, a detailed strategic environmental assessment of the 2009 Food Security Strategy found that the strategy was likely to cause direct or indirect environmental impacts through land degradation, impacts on water quality and quantity, and reduced genetic diversity. It was recommended that food security programming follow sustainable practices, promoting environmentally beneficial approaches such as conservation agriculture, drip irrigation and integrated pest management (GAC, 2014a).

In 2015, the federal government launched a review of Canada's international assistance approach. This aimed to develop a new framework for helping the poorest and most vulnerable countries, and supporting fragile states, while advancing implementation of the UN 2030 Agenda on Sustainable Development. Clean economic growth, climate change, and water have been identified as key areas of focus. The new framework is to be launched in 2017.

6.2. Trade and the environment

North American partnerships

Collaboration on environmental policies in North America is important to Canada. More than 70% of exports are destined for the United States, and Mexico is a growing competitor in the US market. Therefore, environmental policy alignment and collaboration can help ensure a level playing field. The North American Agreement on Environmental Cooperation (NAAEC), which came into force in 1994 along with the North American Free Trade Agreement (NAFTA), requires that each party – Canada, the United States and Mexico – ensure its laws provide for high levels of environmental protection and enforce those laws effectively. It also established the Commission for Environmental Cooperation, comprised of cabinet-level representatives from each of the three countries, to promote trilateral co-operation and address common environmental issues and concerns (ECCC, 2016b). A number of additional North American agreements and initiatives are in place, and Canada has aligned several major environmental policies with the United States, such as light- and heavy-duty vehicle regulations (see Chapter 4).

While a number of new partnerships have recently been established,[16] it is unclear following the November 2016 presidential election whether the United States remains committed to implementing them fully. In February 2017, the US House of Representatives voted to overturn a rule that sought to reduce methane emissions from the US oil and gas industry on federal lands (Daly, 2017). This rule is one element of the US plan for implementing the joint Canada-US agreement, made in March 2016, to simultaneously reduce methane emissions from the oil and gas sector by 40% to 45% below 2012 levels by 2025. The US Senate, however, subsequently rejected the bid. Canada announced proposed regulations to implement the commitment in May 2017; related regulations are under development in Alberta. As announced, the federal regulations would come into force between 2020 and 2023.

Trade agreements

Canada is among OECD leaders in incorporating environmental considerations and obligations into its free trade agreements (FTAs). Many of its agreements established specific mechanisms to resolve conflicts on environment-related matters, or institutions entrusted with identifying or developing environmental co-operation, for example in areas

where the parties can share knowledge and experience (Box 3.6). Canada's approach to environment in FTAs has evolved over the years. While environment provisions were initially included in a parallel environment agreement, they have been included in a substantive environment chapter in recent agreements. Canada is also actively engaged in the negotiations of the World Trade Organization's (WTO) Environmental Goods Agreement. Canada also implemented the 2012 Asia-Pacific Economic Co-operation (APEC) Leaders' commitment to reduce applied tariffs to 5% or less by 2015 on the agreed list of 54 environmental goods.

Box 3.6. **Canada and Chile co-operate on sustainable development of minerals and metals**

In 2008, the Prime Minister of Canada and President of Chile signed a declaration covering five memoranda of understanding (MOU) to strengthen co-operation between the two countries. One MOU in the area of co-operation for the sustainable development of minerals and metals aims to promote eco-innovation and green technologies. The MOU focuses on knowledge-sharing on environmental and natural-resource technologies and the exchange of best practices in areas such as corporate social responsibility, natural-resource governance and community engagement. For example, the Canadian Embassy in Chile has since published an adaptation of Canada's Mining Tool Kit for Aboriginal communities in Spanish to support a more informed and proactive dialogue between Chile's government, companies and communities.

Source: GoC (2012).

Canada is one of the few OECD member countries with enacted legislation that makes it obligatory to assess potential environmental impacts of a trade agreement. Under the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals, Global Affairs Canada is required to undertake environmental assessments of trade negotiations. To facilitate the process, a handbook and framework were prepared to guide federal government officials in their assessment, inter-departmental co-ordination and external consultations. The assessments help negotiators understand and integrate environmental considerations into the agreements, and address public concerns. A final environmental assessment is also prepared based on the negotiated outcome.

Corporate social responsibility

Canada was one of the original adherents to the 1976 OECD Declaration on International Investment and Multinational Enterprises and its guidelines. In 2009, Canada also developed a Corporate Social Responsibility (CSR) Strategy specific to its extractive sector operating abroad, including oil, gas and mining. The strategy, updated in 2014, promotes and advances international CSR standards and guidance, fosters networks and partnerships, and assists dispute resolution between project-affected stakeholders and Canadian companies. Companies found to not be embodying CSR best practices and not engaging in good faith with the government's dispute resolution mechanisms face denial or withdrawal of trade advocacy and economic support from the government. This action has already been taken in one case that involved an environmental issue (GAC, 2014b).

Canada voluntarily implements the OECD Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due

diligence, first adopted in 2003 and then revised in 2016.[17] Export Development Canada (EDC) is a vocal proponent of special export credit terms and conditions for environmental technologies, agreeing to the specific sector understanding with international Export Credit Group members for renewable energy, climate change mitigation and adaptation and water projects and terms that restrict support to coal-fired electricity generation projects. EDC has also adopted the Equator Principles, a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing (EDC, 2016).

Recommendations on green growth

Policy frameworks to support green growth

- Ensure effective and timely implementation of the Federal Sustainable Development Strategy and the Pan-Canadian Framework on Clean Growth and Climate Change, combined with mechanisms for policy evaluation and adjustment, while more explicitly addressing the social component of sustainable development; ensure that sectoral policies, notably energy policies, are well aligned with both frameworks.

Green taxes and other market-based instruments

- Resist pressure to halt or alter carbon pricing plans due to competitiveness concerns, instead focusing on measures to mitigate those concerns through policy design, revenue recycling and programming targeted at vulnerable sectors; include carbon pricing impacts on businesses, work forces and households in commissioned expert assessments.
- Review the taxation of energy use, taking into account the gradual roll-out of nation-wide carbon pricing, and adjust as necessary to ensure that energy prices adequately reflect the societal costs of GHG and air pollutant emissions; gradually reduce the petrol-diesel gap and increase diesel taxes for commercial and residential use; reform the tax on fuel-inefficient vehicles to optimise incentives for the purchase of lower emission vehicles across all categories.
- Continue to review and adjust tax, royalty and subsidy regimes that encourage fossil fuel production in order to meet Canada's commitment to rationalise and phase-out inefficient fossil fuel subsidies that encourage wasteful consumption by 2025; provincial governments in particular need to make further progress; ensure that Crown royalty and land sale payments are not more favourable for unconventional development than for conventional.

Investing in environmental infrastructure and services

- Pursue a more strategic approach to project selection for infrastructure investment and develop priority lists for infrastructure projects that deliver multiple objectives in partnership between the federal government and provinces, territories and municipalities; ensure cost-benefit analysis of infrastructure projects consider environmental externalities, such as GHG emissions; use the Canada Infrastructure Bank to ensure greater co-ordination and standardisation in green bonds and other tools aimed at leveraging private sector investment in environmental infrastructure.

Promoting eco-innovation and green markets

- Provide stable and higher public investment in R&D; shift away from indirect tax credits towards competitive and transparent grants; ensure that energy-related R&D focuses on reducing and mitigating environmental impacts from fossil fuel activities, rather than encouraging increased oil and gas production; ensure innovation programming extends to renewable energy and energy efficiency and the circular economy.

Recommendations on green growth *(cont.)*

- Foster domestic demand for clean technology and eco-innovations through public procurement, fiscal incentives and information sharing; improve federal-provincial-territorial collaboration to improve access to financing for Canadian clean technology firms; encourage a greater private sector role in research, development and technology adoption.

The social consequences of the transition towards green growth

- Ensure that measures to mitigate the distributional impacts of green growth policies preserve the price signal reflecting negative externalities and are narrowly targeted towards vulnerable households.
- Position Canadians to capture the benefits of green growth by better integrating green skills needs into existing and new skills and training policies, addressing both skilled trades and academic disciplines.
- Fulfil commitments to Indigenous communities to work with them to reduce their vulnerability to climate change and poor water quality, while supporting and encouraging efforts to capture income and job opportunities for them from green growth in areas such as renewable energy and protected area management.

The international dimension of green growth: Environment, trade and development

- Maintain Canada's engagement in international environmental agreements and expand environmentally related development assistance, while pursuing new agreements and partnerships as part of trade agreements with the aim of promoting a level playing field for business, expanding knowledge-sharing and improving environmental outcomes.

Notes

1. The federal government collects these revenues in Nunavut, where devolution has not yet been completed.
2. The Gas Tax Fund is legislated as a permanent source of federal infrastructure funding for municipalities. It provides about CAD 2 billion annually, indexed at 2% a year, with increases applied in CAD 100 million increments. The 2017 federal budget announced that the Gas Tax Fund is projected to grow from CAD 2.1 billion in 2016/17 to CAD 2.3 billion in 2021/22.
3. The British Columbia carbon tax base includes emissions from everyone who combusts fossil fuel in the province, for example. Alberta includes petrol, diesel, natural gas and propane under its carbon levy. Quebec includes the distribution of fossil fuels emitting above the annual threshold of 25 000 tCO_2eq in their cap-and-trade system. Energy use in industrial sectors is also included in the systems. The OECD estimated that in 2012, Alberta taxed gasoline at CAD 0.09, compared to CAD 0.20 in British Columbia and CAD 0.15 in Ontario. Some provinces tax diesel at a lower rate than gasoline; some tax biofuels at a lower rate than gasoline and diesel (OECD, 2013).
4. Taxes and royalties paid for energy production are not incorporated into OECD calculations of environmentally related taxes.
5. In November 2016, Nova Scotia announced that it would introduce its own cap-and-trade system in 2018 (not linked to Quebec and Ontario); New Brunswick has committed to put in place carbon pricing by 2018; Newfoundland and Labrador has adopted enabling legislation for carbon pricing, but has not yet provided a timeline for implementation. Manitoba agrees in principle to carbon pricing, but has not yet signed the PCF.
6. In 2012, the majority of OECD member countries applied an effective carbon rate of at least EUR 150 per tonne of CO_2 on at least 10% of national emissions (rates on road sector emissions are usually highest). By comparison, Canada would, in 2022, apply an effective carbon rate of about EUR 75/tonne to 10-15% of emissions; another 50-60% of emissions would be subject to an effective carbon rate of about EUR 40/tonne. The 2022 effective carbon rate in Canada for non-road sectors is in the order of magnitude of those applied in Italy and Finland in 2012. In the road sector, Canada's 2022 rate would

remain low compared to the 2012 levels of other OECD member countries. These rough calculations are based on the OECD (2016e) calculations for effective carbon rates in the OECD for 2012. They exclude provincial product-specific taxes on energy use. The simulation is based on the assumption that the coverage of the national carbon price in Canada would be about 70%, that the composition of CO_2 emissions remains constant (as in 2012) and that federal excise taxes on energy use remain constant (as in 2012).

7. Market price support for milk accounts for the largest share of Canada's support. Prices received by farmers are on average 7% higher than those observed in world markets (OECD, 2016b).

8. For example, Alberta has committed to 30% renewable electricity by 2030, British Columbia requires 93% of electricity to come from clean sources, Nova Scotia is moving to 40% renewables by 2020.

9. In British Columbia, provincial, municipal and federal investments have led to almost 600 public charging stations installed, the government of Ontario has pledged to build 500 new public charging stations, and Quebec has over 1 000 free and fee-based electric charging stations across the province.

10. For example, the CAD 2 billion over 11 years provided for rural and northern communities will in part support their transition from diesel to renewable sources of energy. In addition, the "Smart Cities Challenge" announced by the government of Canada is expected to provide financing of CAD 300 million over ten years for municipalities that create ambitious plans to improve the quality of life of urban residents, including through green buildings and smart road and energy systems (Finance Canada, 2016a, 2017). The Green Municipal Fund also helps finance innovative municipal green infrastructure priorities, providing CAD 700 million to projects across the country since 2000 (Finance Canada, 2016b).

11. Export Development Canada (EDC), a federal Crown corporation, issued green bonds of USD 300 million in 2014 and 2015 to promote investment in environmental infrastructure. The proceeds are used to support eligible projects in areas such as renewable energy, waste and water management, and public transportation.

12. The Innovation and Skills Plan's six key areas are: clean technology, clean resources (such as renewable energy), advanced manufacturing, agri-food, digital industries and health/bio-sciences. The plan includes the establishment of a new organisation, called Innovation Canada, to lead implementation of the plan's innovation component and become a one-stop shop for innovators to access government innovation programmes. The 2016 and 2017 federal budgets supported the plan with investments of CAD 2 billion for renewal and expansion of infrastructure at universities and colleges and CAD 800 million over four years to strengthen innovation networks and clusters (ISEDC, 2017).

13. Mission Innovation is a global initiative of 22 countries and the European Union to accelerate global clean energy innovation. Participating countries have committed to double their governments' clean energy R&D investments over five years, while encouraging greater levels of private sector investment in transformative clean energy technologies. See *http://mission-innovation.net*.

14. The 2017 federal budget created a new procurement programme, Innovative Solutions Canada, which allocates a portion of funding from federal departments and agencies to early-stage research in exchange for access to the latest, most innovative products and services. The programme is designed to allow other Canadian jurisdictions to join over time.

15. Under the Canadian Environmental Assessment Act and the 2010 Cabinet Directive on Strategic Environmental Assessment, Global Affairs Canada, like other federal departments, is obliged to integrate environmental considerations into development activities and those undertaken by development partners (GAC, 2014a).

16. These include a Memorandum of Understanding Concerning Climate Change and Energy Collaboration and an associated action plan (signed in February 2016) and the North American Climate, Clean Energy and Environment Partnership (announced in June 2016 at the North American Leaders Summit). The partnership includes activities related to advancing clean and secure power, driving down short-lived climate pollutants, promoting clean and efficient transportation, protecting nature and advancing science and showing global leadership in addressing climate change (GoC, 2016b).

17. The agreement commits members to adhere to international environmental and social best practices in relation to the provision of export credits and to report on the environmental and social impacts of transactions.

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PART II

Progress towards selected environmental objectives

PART II

Chapter 4

Climate change mitigation in electricity generation and transport

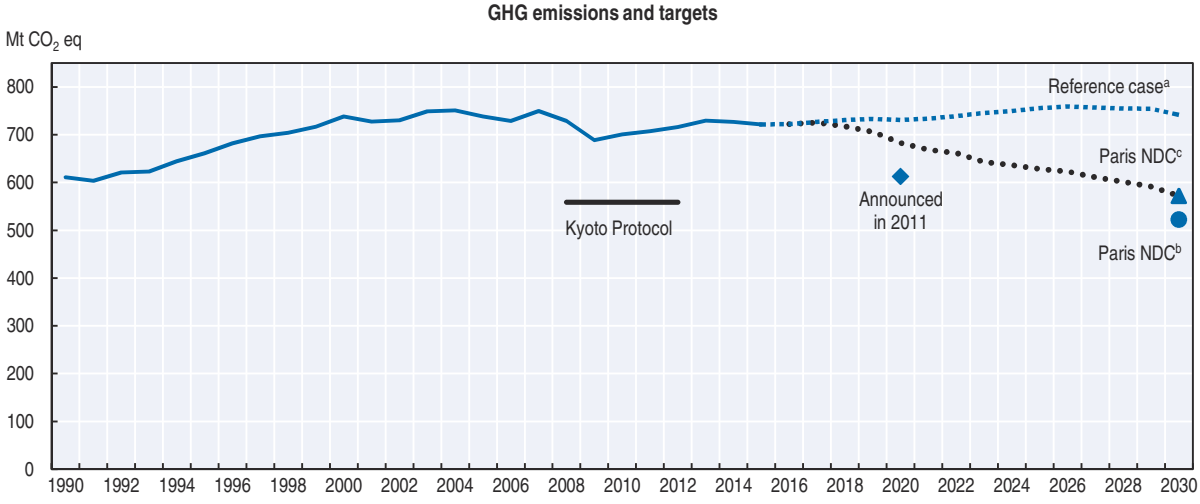
Canada's greenhouse gas emissions are among the highest in the OECD on a per capita basis. Emissions are almost 20% above the 1990 level, and have fallen back only slightly since 2000. Meeting the 2030 emissions reduction target will require a major shift in policy. Recognising this, Canada developed the first-ever overarching plan to meet the target in a co-ordinated approach among federal, provincial and territorial levels. This chapter discusses Canada's climate policy and some of the challenges involved in its climate targets. It focuses particularly on electricity generation and transport.

1. Introduction

The 2004 *Environmental Performance Review* (EPR) encouraged Canada to "aggressively implement the [2002] Climate Change Plan for Canada", using a broad array of instruments. The plan had set out principles and steps for meeting Canada's greenhouse gas (GHG) emission reduction target under the Kyoto Protocol, from which Canada withdrew in 2011. Even though the plan has never been implemented, a number of climate policies have been introduced, most notably at the provincial and territorial level. Notwithstanding, a decade after the last EPR, Canada's GHG emissions had fallen back only slightly compared with the 2000 level, and were almost 20% above the 1990 level. While emissions in electricity generation had been cut, they grew substantially in domestic transport and in the oil and gas extraction industry.

The 2016 Pan-Canadian Framework on Clean Growth and Climate Change (PCF) represents the first time since 2002 that concrete steps to develop a nationwide strategy have succeeded. The PCF aims to reduce emissions by 30% from 2005 levels by 2030, in line with the target Canada set in its nationally determined contribution (NDC) under the Paris Agreement. Achieving the target will be challenging, even if it leaves emissions not much below the ambition embodied in the Kyoto Protocol (Figure 4.1). The PCF envisages a wide range of actions to reduce economy-wide emissions – many of which are yet to be implemented. Canada's mid-century climate strategy recognises that much more will be needed after 2030 to bring Canada's emissions on a path consistent with the global objective of keeping warming below 2°C.

Figure 4.1. **Meeting Canada's 2030 GHG emission reduction target will be challenging**



a) Government of Canada emissions projections with policies and measures in place as of 1 November 2016.
b) Canada's Nationally Determined Contribution (NDC) under the Paris Agreement, including purchases of international credits.
c) Canada's Nationally Determined Contribution (NDC) under the Paris Agreement, domestic reduction only.
Source: ECCC (2017), *National Inventory Report 1990-2015*; country submission.

StatLink http://dx.doi.org/10.1787/888933565716

This chapter discusses Canada's climate policy and some of the challenges involved in its GHG mitigation targets. It focuses particularly on electricity generation and transport. Canada has huge potential for zero-carbon electricity generation, but also huge reserves of cheap fossil fuels, with the balance varying widely across the provinces and territories. The challenge is to find cost-efficient policies that exploit national advantages, while considering the regional variation. Emissions from transport continue to rise, alongside higher incomes and increased demand for travel and freight transport. Low- or zero-carbon transport technologies are increasingly available, but still suffer from a combination of high cost and/or lack of appropriate infrastructure. A good balance between use of carbon pricing, vehicle emission standards, fuel standards, and other kinds of regulations or voluntary agreements, paying attention to the needs of different transport sectors, needs to be found.

2. State and trends in GHG emissions

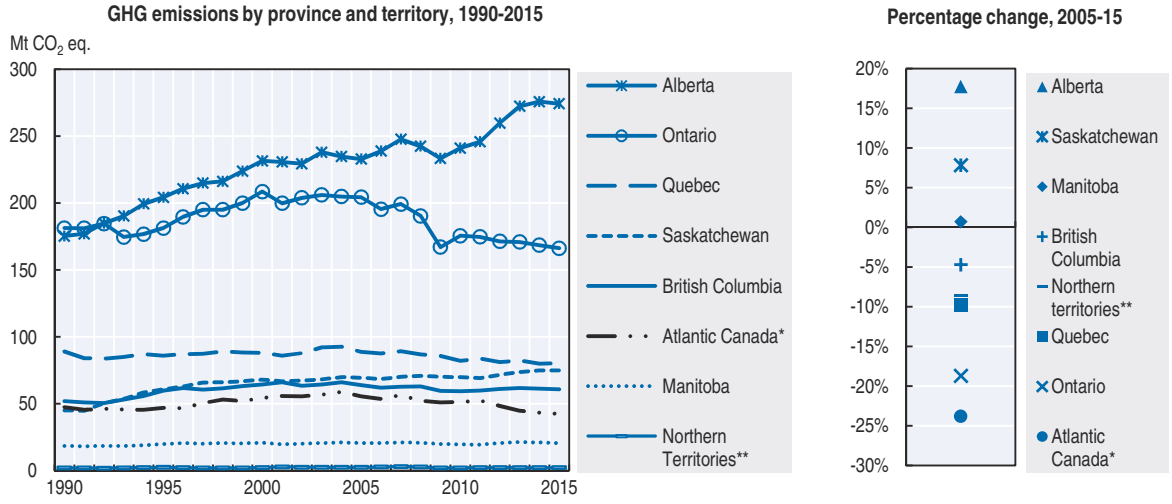
In 2014, Canada was the fourth largest emitter of GHG emissions in the OECD in absolute terms, excluding land use, land-use change and forestry (LULUCF). It accounted for about 5% of total OECD emissions, compared with its 2.8% share of population, or 3.2% of gross domestic product (GDP) (OECD, 2017a). Emissions in 2015 reached 722 million tonnes of carbon dioxide equivalent (CO_2eq), 18% above 1990 levels and 2.2% below 2005 levels (ECCC, 2017). In 2008-12, the first period of the Kyoto Protocol, emissions were 20% above the 1990 level, rather than 6% below as foreseen in the protocol. Emissions stayed relatively stable in the first half of the 2000s, with a dip during the 2008/09 financial crisis; unlike in most other OECD member countries, they increased thereafter (Figure 4.1).

Although emissions have begun to decrease slightly since 2013, meeting the 2030 mitigation objectives will be difficult given Canada's current and foreseeable emissions profile. Under business as usual conditions (with policies in place as of November 2016), GHG emissions are projected to peak in 2026. They will likely decline thereafter, though not enough to meet the 2030 targets (Figure 4.1). New climate policies foreseen under the PCF would, if fully implemented, put Canada on the right path according to government projections. The government may use international mechanisms to achieve the 2030 target, but domestic emissions are expected to provide more than three-quarters of the reduction. Canada's Mid-Century Long-Term Low-Greenhouse Gas Development Strategy, issued in 2016 as a discussion document, examines a pathway that would bring emissions in 2050 to 80% below the 2005 level. This implies a cut between 2030 and 2050 nearly twice that planned between now and 2030. Much more will therefore need to be done after 2030. Indeed, the 2030 target itself could be tightened for consistency with the internationally agreed objective to keep global warming within 2°C.

Emissions have decreased in all provinces and territories since 2000, except in Alberta and Saskatchewan (Figure 4.2). Alberta accounted for 38% of Canadian emissions in 2015, reflecting the province's large energy-intensive extractive industry, notably the oil sands. Ontario, the most populated province, was the second largest emitter of GHGs, accounting for 23% of Canadian emissions in 2015. It saw the most significant decrease in emissions, largely due to the phase-out of coal in electricity generation. The sparsely populated northern territories accounted for only 0.3% of national emissions.

The energy sector is responsible for the lion's share of national GHG emissions. The oil and gas industry accounted for about one-quarter of total emissions; adding in fuel combustion by power plants, industry and transport brings the energy sector to above 80%. The most dramatic increases occurred in the oil and gas sector and in transport, with

Figure 4.2. **Emissions have risen dramatically in Alberta, while they decreased significantly in Ontario**

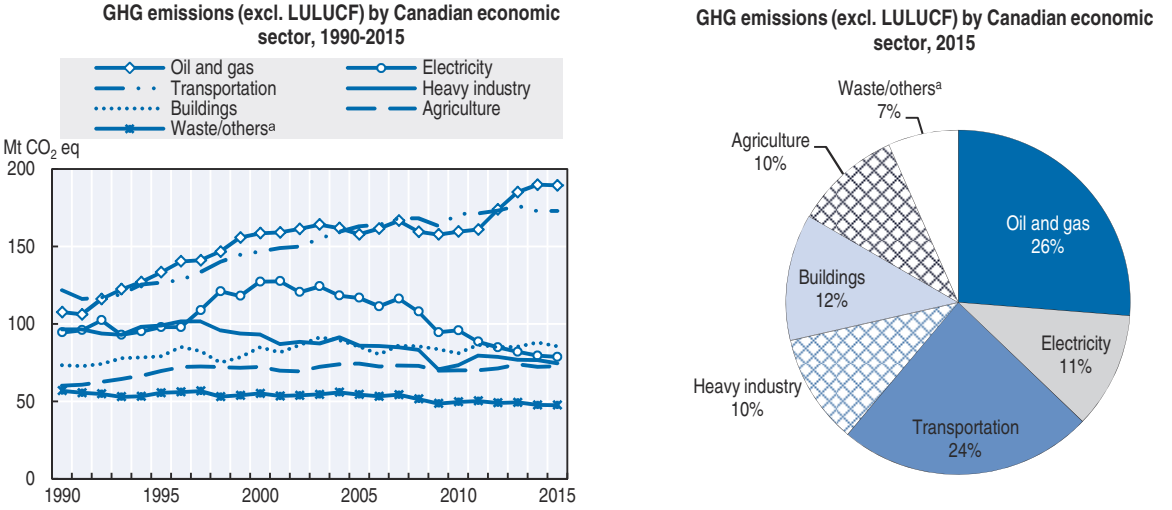


Note: GHG emissions excluding LULUCF.
* Newfoundland and Labrador, Prince Edward Island, Nova Scotia and New Brunswick. **Yukon, Northwest Territories and Nunavut.
Source: ECCC (2017), *National Inventory Report 1990-2015.*

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increases of nearly 80% over 1990-2015, or 20% over 2000-15 (Figure 4.3). By contrast, emissions from electricity generation decreased significantly (by 38%) over 2000-15, mostly driven by the phase-out of coal in Ontario. Emissions from industry (other than oil and gas) have also decreased (by 20% since 2000); emissions from agriculture and buildings have stayed relatively stable. Canada has one of the world's least carbon-intensive power sectors, due to a high share of hydro and nuclear power (Section 4). However, fossil fuels continue to dominate Canada's total primary energy supply (see Chapter 1). As a consequence, energy-related GHG emissions have continued to increase along with energy use in the economy.

Figure 4.3. **The oil and gas industry and transport have driven the increase in emissions**



a) Includes coal production, light manufacturing, construction and forest resources (3.2% of total GHG emissions in 2015).
Source: ECCC (2017), *National Inventory Report 1990-2015.*

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CO_2 accounted for 79% of Canada's total GHG emissions in 2015, mostly from combustion of fossil fuels. Methane is estimated to have accounted for 14%, mostly due to fugitive emissions from oil and gas industries. Measurement of methane is challenging and statistics are poor. A recent report suggests that fugitive emissions from parts of the Alberta oil and gas industry could be underestimated by as much as 60% (Environmental Defence Canada, 2017). If this latter figure is accurate, total national GHG emissions are being underestimated by nearly 4%. N_2O emissions from agricultural soil management and transportation accounted for 5% of total GHG emissions, and F-gases from industrial processes accounted for some 2% (ECCC, 2017).

Canada's LULUCF sector acts as a net carbon sink (i.e. it absorbs more CO_2 than it emits through land and land-use change activities such as deforestation) (ECCC, 2017). In 2015, the sector's net emissions reached -34 million tonnes of CO_2eq, meaning it reduced total Canadian emissions by nearly 5%. However, there is high variability in emissions and removals from Canada's LULUCF sector. This is due to large variations in emissions from forest land as a result of natural disturbances. In some years, for example, wildfires release significant emissions in managed forests. The extensive Mountain Pine Beetle infestation in Western Canada is also responsible for considerable emissions from tree loss. Canada's 2017 GHG inventory for the first time excludes the impact of natural disturbances on LULUCF net emissions. This improved approach has led to significant recalculations for anthropogenic emissions and removals estimates in the LULUCF category (ECCC, 2017).

Despite improvement, Canada's emissions intensities remain among the highest in the OECD. In 2014, GHG emissions per capita were 20.5 tonnes of CO_2eq – significantly above the OECD average of 12.4 tCO_2eq. GHG emissions per unit of GDP (USD, 2010 PPPs) were 0.49 kg of CO_2eq – also above the OECD average of 0.34 kgCO_2eq (OECD, 2017a). High emission intensity partly results from Canada's geography and industrial structure. Its northern location and long distances between major population and industrial centres result in high demand for transport and heating. At the same time, key energy extraction industries themselves emit large quantities of GHGs both as combustion products and fugitive emissions. Emission intensities are particularly high in Alberta and Saskatchewan, the centre of Canada's production of oil and gas, as well as coal. Canada is among the world's largest producers and exporters of oil and natural gas.

3. The evolution of climate change policy

3.1. Division of powers and institutional framework

Provinces have wide-ranging responsibilities, including in the area of environmental policy, energy policy and the management of natural resources within their boundaries (see Chapter 2). Indeed, most key policy tools for GHG mitigation are the responsibility of provinces and territories. The federal government has the jurisdiction to regulate GHG emissions under the 1999 Canadian Environmental Protection Act (CEPA). Indirectly, it also regulates emissions through the 1992 Energy Efficiency Act. This legislation provides authority to regulate minimum energy efficiency standards for energy-consuming products and product labelling.

Several institutions are involved in developing and implementing climate change policies at the federal level. Environment and Climate Change Canada (ECCC), the lead ministry for domestic and international climate change policy, has the main responsibility for regulation of GHG emissions. Natural Resources Canada (NRCan) is the primary body

responsible for federal energy efficiency and renewable energy policy. NRCan and ECCC are also responsible for alternative fuels policy and vehicle emissions regulations. Transport Canada governs emissions and efficiency regulations for other transport modes – rail, air and marine. Indigenous and Northern Affairs Canada (INAC) works with Indigenous and northern communities to build resilience to climate change and address energy-related issues, including supporting the deployment of proven forms of renewable energy that reduce GHG emissions. The institutional framework for climate policy varies at the provincial level (IEA, 2016).

Canada's federal structure and assignment of competences makes it imperative for the federal, provincial and territorial governments to work closely together to translate international commitments into domestic climate action. Negotiation, rather than imposition, is the typical approach for the federal government, with the risk it will be unable to meet its international commitments. The federal, provincial and territorial governments collaborate on climate action mainly through the Canadian Council of Ministers of the Environment (CCME). A Climate Change Committee was established in June 2015 to facilitate ongoing federal/provincial/territorial engagement on climate change.

3.2. National targets and objectives

Canada was a signatory to the Kyoto Protocol of the UN Framework Convention on Climate Change (UNFCCC), having formally ratified the protocol in 2002. Under the protocol, Canada committed to cut GHG emissions by 6% from 1990 levels during the first commitment period of 2008-12. In 2006, the government formally recognised it would not meet the Kyoto target; Canada withdrew from the protocol in 2011. It did not take on a commitment under the second commitment period. It decided to withdraw based on its assessment of the costs of meeting the protocol, its limited coverage of global emissions and, in particular, the absence of the United States from the protocol (EC, 2012).

In 2007, before Canada's withdrawal from the Kyoto Protocol, the federal government announced new targets: an emissions reduction of 20% below 2006 levels by 2020, and 60-70% below 2006 levels by 2050. The federal government's implementation plan, *Turning the Corner*, focused on a reduction of emissions intensity. It intended to reduce industrial emissions per unit of output by 6% per year up to 2010 and by 2% per year thereafter. It also proposed regulating industrial emitters through a tradable credit system. However, many of its key provisions were opposed in Parliament, and no attempt was ever made to enforce the reductions in emissions intensity. Given the level of integration in the North American economy and developments within its southern neighbour, the federal government instead chose to pursue harmonisation of emissions reduction policies and regulations with those of the United States (IEA, 2016).

Two years later, at the 2009 Copenhagen meeting of the parties to the UNFCCC, Canada pledged to reduce GHG emissions by 17% below 2005 levels by 2020, stating this target is "to be aligned with the final economy wide emission reduction target of the United States in enacted legislation" (UNFCCC, 2017). Under the Paris Agreement, which Canada ratified in October 2016, Canada committed to reduce emissions by 30% from 2005 levels by 2030 (GoC, 2016a). The target includes LULUCF (which is a net sink in Canada, see Section 2) and allows for use of international mechanisms to achieve the target. The NDC notes that some sector-based policies have been aligned with those in the United States; it may be implicit this is expected to continue. However, the NDC does not repeat the wording of the 2020 objective to the effect that it may depend on US policy.

3.3. Towards a national response to climate change: The pan-Canadian framework

Until recently, climate change policy was driven mainly by provincial initiatives, without an overall pan-Canadian strategy or framework. Federal climate policy has largely focused around sector-specific intensity-based standards (Section 3.4). The PCF was foreshadowed in early 2016 by the Vancouver Declaration by the First Ministers of the federation, provinces and territories and formalised in late 2016 to help the country achieve its NDC commitment. It was developed in a collaborative manner and in consultation with Indigenous organisations. Both this move and the Alberta Climate Leadership Plan, which preceded it by a few months, represented a significant shift in political will back towards concerted action on climate change; Ontario, Quebec and British Columbia had introduced similar plans earlier. The PCF has four main pillars: pricing carbon pollution; complementary mitigation action across sectors; adaptation and climate resilience; and clean technology, innovation and jobs.

Carbon pricing as a foundation of the PCF

Carbon pricing is to be expanded across Canada using a benchmark approach: by 2018, provinces and territories will have to have their own carbon pricing system in place that must meet minimum requirements set by the federal government. Such a system can take the form of either a carbon tax, a cap-and-trade system or a hybrid approach (e.g. a carbon levy combined with an output-based pricing system, such as in Alberta, see Chapter 3). For any jurisdiction that lacks a system aligned with the benchmark, a federal carbon pricing backstop system will apply. Four provinces already have a carbon pricing mechanism in place (Table 4.1). The direct revenue remains in, or will be returned to, the jurisdiction in which it originates. Most provinces and territories have agreed on the principle (at the time of writing, Saskatchewan and Manitoba had not signed up). The precise mechanism and regulations have yet to be designed, even though it is intended to be in place by 2018. The minimum price under the federal benchmark will be CAD 10 per tonne in 2018, rising by CAD 10 per year to CAD 50 per tonne by 2022. For cap-and-trade systems, the benchmark requires: i) a 2030 emissions reduction target equal to or greater than Canada's 30% reduction target; and ii) a decline of annual caps to at least 2022 that corresponds with projected emission reductions from the carbon price in price-based systems. Quebec's cap-and-trade system already has minimum and maximum prices that are to rise through time. The minimum (currently under CAD 14) is less than that planned under the PCF; the maximum is currently CAD 50 to CAD 64, rising, under current legislation, by 5% per year in real terms.

Other key components of the PCF

There are several other important mitigation plans under the PCF. As already foreseen by most provinces, coal-generated electricity will be phased out by 2030. Further, Canada will work towards net-zero energy-ready building codes by 2030, developing a clean fuel standard based on life-cycle emissions (this may replace the more arbitrary biofuel content mandates in place for some fuels), reduce methane emissions in the oil and gas industry by 40-45% and increase carbon storage in forests and agricultural lands. The government of Canada has announced a CAD 2 billion (0.1% of GDP) Low Carbon Economy Fund to directly support initiatives in the PCF. As part of a major infrastructure investment programme (see Chapter 3), the government has also announced investments of around CAD 70 billion (about 4% of GDP) over ten years in public transit infrastructure, green infrastructure, trade and transportation infrastructure and clean technology. Much of the "green" part of this investment will be directed towards supporting mitigation and adaptation initiatives

Table 4.1. **Carbon pricing systems in Canada**

Design element	British Columbia	Quebec	Alberta	Ontario
Mechanism	Carbon tax	Cap-and-trade emissions trading system	Hybrid offset system: offset trading system for large facilities (with trading around intensity targets), combined with a carbon levy	Cap-and-trade emissions trading system (linked to Quebec and California as of 2018)
Coverage	All emissions from fossil fuel combustion (by both businesses and individuals). About 70% of BC's emissions are covered. Agricultural, landfill, fugitive and industrial process emissions are not covered.	All emissions from fuel combustion (by both businesses and individuals) plus industrial process emissions. About 85% of Quebec's emissions are covered. Agricultural and landfill emissions are not covered.	The offset trading scheme covers large emitters. Since 2017, fossil fuels for transportation and heating are covered by a carbon levy. Among large emitters, only emissions above the facility-specific intensity targets were initially subject to a charge. As of 2018, Alberta will tax all emissions, while giving large emitters sector-specific, output-based, free allocations of emissions rights. The offset system and carbon levy together cover 78-90% of Alberta's emissions. Neither system covers agricultural or fugitive emissions.	All emissions from fuel combustion (by both businesses and individuals) plus industrial process emissions. Agricultural and landfill emissions are not covered.
Flexibility mechanisms	N/A	Facilities covered by the emissions trading system comply by surrendering allowances, offset credits from projects in uncovered sectors or early reduction credits. Linking to the Californian system broadens access to low-cost abatement opportunities.	Facilities covered by the offset trading system comply by surrendering freely allocated allowances (which can be traded), surrendering offset credits from projects in uncovered sectors or by paying a carbon levy.	Facilities covered by the emissions trading system comply by surrendering allowances, offset credits from projects in uncovered sectors or early reduction credits.
Use of revenue	All revenue from the carbon tax is used to fund tax reductions for businesses and individuals.	Revenue from auctioning allowances funds Quebec's 2013-20 Climate Change Action Plan, which comprises programmes supporting companies, municipalities and individuals to reduce emissions and adapt to the impacts of climate change.	Two-thirds of revenue from the carbon levy will fund green technology and infrastructure projects; one-third will fund rebates and tax cuts to help households, businesses and communities adjust to the carbon levy.	Revenue from auctioning allowances to be used in GHG reduction programmes.
Emissions- intensive, trade-exposed industries	No relief or exemptions provided.	Receive an output-based allocation of allowances. This was initially based on the average historic emissions intensity of each facility, but from 2015-20 the number of free allowances per unit of production generally decreases by 1-2% per year.	Receive an output-based allocation of allowances. As from 2018 this will be based on a benchmark set relative to high-performing industry peers or competitors that produce the same or similar products.	Receive a free output-based allocation of allowances.
Price per tonne of CO_2	CAD 30 (since 2012)	CAD 17.84 (settlement price, February 2017 auction)	CAD 20 (2017); CAD 30 (2018)	CAD 18.08 (settlement price, March 2017 auction)

under the PCF. About CAD 9 billion will be channelled through provinces and territories, and CAD 5 billion through the Canada Infrastructure Bank.

Emission projections under the PCF

Baseline ECCC projections foresee, on current policies, a level of emissions in 2030 roughly unchanged from 2015, at 742 million tonnes of CO_2eq; to meet targets, emissions should actually be 523 Mt, 30% below the 2005 level and 15% below the 1990 level. The PCF does not specify in detail which measures will achieve how much. However, it does

anticipate that out of the total planned reduction of 219 Mt, 89 Mt will come from measures announced in 2016. These include regulations on hydroflurocarbons (HFCs), heavy duty vehicles and methane, as well as the British Columbia and Alberta Climate Leadership Plans, Saskatchewan's renewables target and credits from abroad in the cap-and-trade programmes. Another 86 Mt would come from new measures in the PCF, such as the final coal phase-out, building regulations and retrofitting, the new clean fuel standard and industry-specific measures. This leaves 44 Mt to be found from further measures (Table 4.2). About a quarter of the reduction is expected to be met by purchasing credits from abroad.[1]

Table 4.2. **Pathway to meeting Canada's 2030 target**

	GHG emissions in 2030 (in Mt CO_2eq)	Reduction due to policy (in Mt CO_2eq)	Policy measures
ECCC Reference case projections, with policies and measures in place as of November 2016	742		Federal measures: measures for energy efficiency of equipment in buildings (announced under Budget 2016). Provincial measures: coal phase-out, CAD 30 carbon levy and 100 Mt cap on oil sands emissions (Alberta), cap-and-trade (Ontario), building regulations for new high-rise buildings (Quebec).
Announced measures (as of November 2016)		34	Federal measures: HFC regulations, heavy-duty vehicles (phase 2) regulations, methane regulations for oil and gas sector. Provincial: renewable electricity announcement (Saskatchewan), methane regulations (Alberta), Climate Leadership Plan (British Columbia).
		55	Ontario and Quebec international purchases of Western Climate Initiative (WCI) allowances.
Measures announced under the in the PCF		86	Measures in all sectors. Also includes federal measures announced in November 2016 (coal phase-out by 2030 and clean fuel standard).
Additional measures		44	Includes investments in public transit and green infrastructure; technology and innovation; increases in stored carbon in forest, soils and wetlands; and any future actions by governments.
PCF Target	**523**		

Source: Modelling of GHG projections, Government of Canada, December 2016, *www.canada.ca/en/services/environment/weather/climatechange/climate-action/modelling-ghg-projections.html*.

Because the expected impacts of many specific measures are not quantified, it is hard to verify whether the numbers "add up". At this stage, lack of certainty is not a weakness of the approach; it is simply realistic. Cross-sectoral interactive effects can also make it difficult to attribute particular reductions to particular measures. Projections and estimates are essential to assessing whether policy is on track. However, if not used carefully, they can lend a spurious precision to analysis. In line with the approach taken in the Paris Agreement, Canada will need both to make objective (even though uncertain) estimates of the likely impact of its different policies, and plan periodic and preferably independent assessments of policies' outcomes to adjust policy over time. Canada has provisions for performance-based analysis of policies, but they do not always go far enough in considering the ultimate aims of policies (Box 4.1).

Box 4.1. **Use of performance information in policy evaluation: Natural Resources Canada's Renewable Energy Deployment sub-programme**

Natural Resources Canada provides easy public access to an impressive range of audit and evaluation reports on its own activities and programmes. These include an evaluation of the Renewable Energy Deployment sub-programme (NRCan, 2015). The report demonstrates that information is in principle available to assess costs and benefits and reports that procedures

Box 4.1. **Use of performance information in policy evaluation: Natural Resources Canada's Renewable Energy Deployment sub-programme** *(cont.)*

are in place to save programme costs. However, many of the evaluated incentives do not refer to concrete results from the programme. Instead, they refer to the dollar value of likely investment under the programme. They also note surveyed opinions that without the programme "current [renewable energy] capacity would have taken longer to attain". A cost-benefit approach would require, in addition, information on the quantity of GHG emissions saved (assuming the programme's basic aim is GHG mitigation), as well as on the costs of the programme to both government and the private sector. Its definition of costs seems restricted to budgetary costs. For example, a "1:10 leveraging of federal funding" (i.e. private investment in renewables of approximately ten times the programme's fiscal cost) is reported as positive. On its own, however, the ratio would be irrelevant in a society-wide cost-benefit analysis.

In fact, many of Canada's programmes for support for renewables are indeed likely to be relatively cost effective to the extent that the utility solicits bids for capacity from private sector suppliers. Provided the bidding process is open and competitive, this reverse-bidding procedure at least ensures that targets for renewables are reached cost efficiently. According to OECD (2015a), reverse bidding is indeed the most common method in Canada; the feed-in tariff approach may be used for smaller installations.

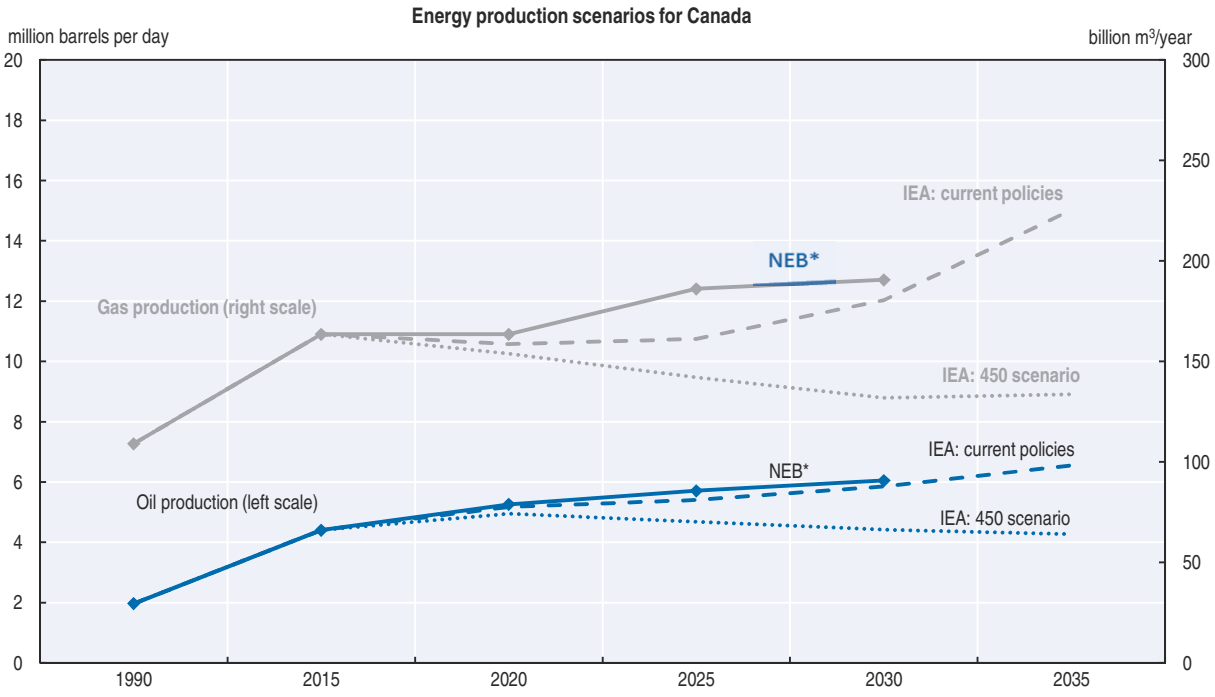
The impact of external demand for hydrocarbons

GHG emissions will depend on one key factor outside Canada's control: world demand and prices for hydrocarbons. Canada's current projections foresee an increase in its production and exports. If serious steps are taken internationally to implement the Paris Agreement and limit the rise in atmospheric CO_2 concentration to 450 parts per million (ppm), International Energy Agency projections suggest that Canada's production of oil and gas in 2030 could be as much as one-third less than its "current policy" projections. This would be equivalent to 6% less than 2015 production for oil and 17% lower for gas (Figure 4.4). The US government has recently announced it will allow the construction of the Keystone XL and Dakota Access pipelines for delivering Canadian oil into the United States. Other pipelines within Canadian territory, which allow access to the Pacific Ocean for exports, are also planned. It is unclear whether all this planned construction implies higher production or possibly excess pipeline capacity (Gunton, 2017). As Hughes (2016) suggests, even using only existing pipeline capacity to the full would likely result in GHG emissions from Alberta's oil and gas sector exceeding the recently announced annual ceiling of 100 Mt – unless new technology can radically reduce the emissions intensity of extraction, refining and transport.

3.4. Climate change policy prior to 2016

Most of the important steps in climate change policy, in terms of their impact on the recent evolution of emissions, were taken by provinces and territories. Canada's Second Biennial Update Report to the UNFCCC provides an exhaustive list of measures undertaken across the country. The list shows the country has introduced up to ten or more such measures each year (GoC, 2016b). About half of these measures were reported with an indication of their expected quantitative impact on emissions in 2020. These data are used in Figure 4.5 to indicate the evolution of climate change policy since 2004.

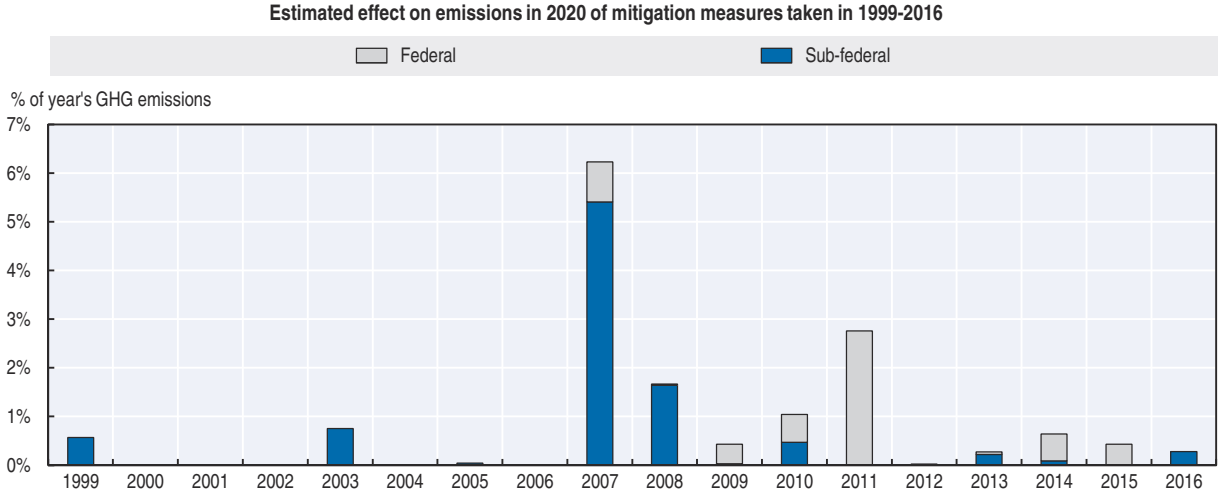
Figure 4.4. **Implementation of the Paris Agreement will cut Canada's oil and gas production**



Note: IEA projections are from the December 2016 IEA World Energy Outlook.
* National Energy Board (NEB) projections for 2020-30 are based on growth rates from 2015 from the NEB's Energy Future Report applied to the same starting point as the IEA projections.
Source: IEA (2016), *World Energy Outlook 2016*.

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Figure 4.5. **Up to now, most emission reductions have occurred due to provincial measures**

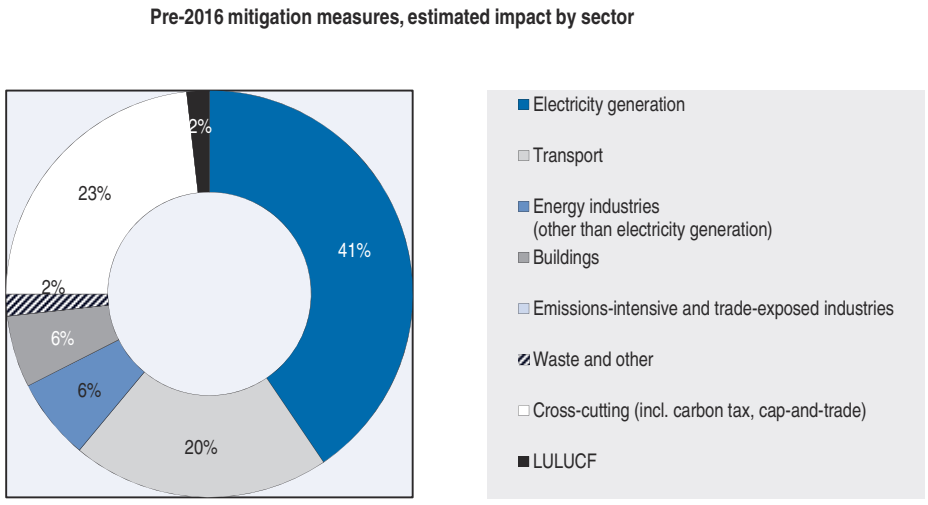


Note: Measures are dated according to the implementation date given in the Second Biennial Report to UNFCCC.
Source: ECCC (2016), *Annex to Canada's Second Biennial Report: Key Policies and Measures Affecting Canada's Greenhouse Gas Emissions.*

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The share of estimated emission reductions due to policy action in different sectors is very different from the sectors' shares in emissions (Figure 4.3 versus Figure 4.6). For example, most estimated emission reductions occurred due to measures related to electricity

Figure 4.6. **Up to now, most emission reductions have been achieved in the electricity sector**



Note: Measures as reported in the Annex to the Second Biennial Report to UNFCCC. Figures are approximate because some measures overlap.
Source: ECCC (2016), *Annex to Canada's Second Biennial Report: Key Policies and Measures Affecting Canada's Greenhouse Gas Emissions.*

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generation, although the sector accounted for a rather small share of total emissions. Agriculture and industries that are particularly emissions-intensive or trade-exposed[2] account for about 20% of total emissions, yet no significant measures, or at least none with quantifiable effects, have been taken. This discrepancy between apparent reduction effort and initial shares may suggest the inefficiencies of a piecemeal approach. This does not follow automatically, however; an efficient set of policies would focus on sectors with low abatement costs, and these will not always be those with the highest emissions.

Federal climate policy

As mentioned earlier, climate policy at the federal level has largely focused around sector-specific intensity-based standards. In 2011, the federal government introduced average emissions standards for light road vehicles. These were essentially equivalent to the US Corporate Average Fuel Economy (CAFE) standards, though expressed in GHG emissions per distance travelled rather than fuel consumption. It also established GHG emission regulation for coal-fired electricity production, whose effect would be to eventually force their closure, as discussed later in this chapter. The federal ecoENERGY programmes were launched in 2007 and implemented in subsequent years, covering a wide range of initiatives. These included, for example, support for investment in renewable electricity, retrofitting of houses, development of building codes and funding for research and development (R&D). The ENERGY STAR (labelling) initiative promoted energy-efficient products, including for buildings, cars and appliances. As well, the ecoENERGY for Aboriginal and Northern Communities Program (EANCP) aimed to reduce northern communities' dependence on diesel-generated electricity.

Examples of provincial and sectoral measures

Most provinces and territories have reduction targets for 2020 and 2050, and measures to achieve them. The focus and design of climate policies vary according to individual priorities and circumstances (IEA, 2016). One of the arguably most important mitigation measures to

date was Ontario's decision to phase out traditional coal-fired electricity generation by 2014 (i.e. coal-fired plants operating without carbon capture and storage). Alberta also announced the phase-out of coal-fired electricity generation by 2030; and a Canada-wide phase-out by 2030 was included in the PCF. Several provinces adopted measures to promote renewable energy and enhance energy efficiency. Some of these measures are discussed in Section 4; mitigation measures in the transport sector are discussed in Section 5.

Many provinces have implemented measures that aim to reduce CO_2 emissions across multiple sectors. British Columbia has a carbon tax and Quebec has a cap-and-trade system linked to California's trading scheme; Ontario launched its programme in 2017 and intends to join the system in 2018. For its part, Alberta has a hybrid system that combines an economy-wide levy with a trading scheme for large emitters. Both Ontario and Quebec have announced reduction targets for 2030 of 37% compared with 1990. This is tighter than the federal target, albeit about a quarter of the reduction is currently expected to come from purchasing external credits in the cap-and-trade system.

Emissions-intensive industry

A small number of measures have addressed emissions-intensive industries, but not in any comprehensive way. Two measures involved financial incentives for specific industries. From 2009-12, Quebec had incentives for pulp and paper, albeit for "environmentally beneficial" capital projects, not just GHG-oriented ones. As of 2016, British Columbia has had subsidies for cement producers to beat emissions-intensity benchmarks. Saskatchewan's 2010 Management and Reduction of Greenhouse Gases Act set a target for large industrial emitters to reduce their 2020 emissions to 20% below the 2006 level, with the option of paying into a technology fund in lieu of compliance. However, implementing regulations have not yet been published, and the act is yet to be proclaimed in force.

Alberta, the most significant emitter, introduced its Specified Gas Emitters Regulation in 2007. This gave large individual emitters (that produce more than 100 tonnes of GHG emissions annually) targets for intensity reduction. The targets covered about half of Alberta's total emissions. Later, under its 2015 Climate Change Leadership Plan, Alberta supplemented this approach with a carbon levy on emissions that exceed facility-specific benchmarks.[3] Under Alberta's Carbon Competitiveness Regulation, expected to be introduced in 2018, this levy will be modified to be payable on all emissions. At the same time, sector-specific, output-based allocations of emissions rights will be issued (see Box 3.4 in Chapter 3 for details). The new system is expected to raise the carbon levy to CAD 30 by 2018. This will take carbon pricing coverage to 78-90% of the province's emissions.

The oil and gas sector

Alberta announced a plan to cap GHG emissions from oil sands at 100 million tonnes, though this is somewhat above current emissions. It is not clear how the province will impose this cap. Apart from Alberta's GHG cap, provincial measures were mainly focused on methane emissions. Methane accounts for about one-quarter of the sector's total GHG emissions, but has a stronger warming potential than CO_2. All provinces hosting the industry have had regulations to limit venting and flaring in place for some time and emissions from this source have reportedly declined by around 15% since 2005. Alberta has also announced a target of 45% reduction in methane gas emissions from its oil and gas operations by 2025 – this was originally a joint initiative with the US industry. British Columbia plans for the same 45% reduction in methane emissions (in its case, from natural gas); and the target was

integrated into the PCF in 2016. The federal government announced intentions to regulate emissions from the oil and gas sector as far back as 2006, but no regulation has been implemented since. Canada, the United States and Mexico jointly committed to reduce methane emissions from the oil and gas sector by 40-45% by 2025. Canada published draft regulations that aim to achieve this reduction target. As proposed, the federal regulations would come into force between 2020 and 2023 (see also Chapter 3).

Three-quarters of the sector's total GHG emissions are CO_2 emitted from fuel combustion used to extract or transport hydrocarbons. CO_2 emissions in the sector have not been targeted directly. A large share of these emissions are covered under provincial carbon pricing mechanisms (including British Columbia's carbon tax and Alberta's Specified Gas Emitters Regulation). However, their impact towards meeting the climate targets has been limited to date (IEA, 2016). From around 2003-11, Canada-wide GHG emissions from the oil and gas extraction and refining industries reached a plateau about 50% above the 1990 level. They resumed growth thereafter, rising nearly 20% over 2011-14.

Measurement of fugitive emissions is difficult and direct measurement or spot checks are rare.[4] According to Environmental Defence Canada (2017), lax monitoring and reporting have led to a large underestimate of the number of devices from which methane may leak. Further, device-specific rates of leakage, often because of poor maintenance, have been significantly underestimated. Environmental Defence Canada (2017) argues that much of the leakage could be eliminated with standard technologies such as those listed in the UN Environmental Protection Agency's Natural Gas STAR Program (EPA, 2017). In many cases, it argues, the captured methane has commercial value; this means the mitigation cost is very low, or negative. Given the under-reporting, the low cost of many mitigation measures, and the fact that some US states already have significantly tighter regulation, Canada should not further postpone regulation on emissions from methane.

The buildings sector

Most provinces improved building regulations; GoC (2016c) shows measures for all provinces and territories other than Alberta and Saskatchewan. Improvements were mostly of two kinds. On the one hand, they required improved overall energy efficiency in new buildings or in new social housing. On the other, they required energy efficiency in specific facilities, such as requiring new homes to provide for solar water heating (British Columbia, some municipalities). Some programmes involve financial assistance to private homeowners. Quebec, for example, provides financial assistance to retrofit existing dwellings with more efficient heating systems or subsidises insurance for new homes that satisfy energy efficiency standards (specified in its Novoclimat programme). Other provinces, including New Brunswick and Prince Edward Island, as well as Yukon and the Northwest Territories, have similar programmes. Nova Scotia and Quebec have programmes primarily focused on improved insulation and heating efficiency in low-income households.

Waste disposal and management

Most provinces and territories also have measures regarding waste disposal and management which target, either directly or indirectly, methane emissions. British Columbia, Manitoba and Ontario have regulations requiring the capture of methane emissions at landfills that are above thresholds for either landfill capacity or annual methane emissions. Quebec has a comprehensive scheme to improve re-use and recycling rates, charging a "royalty" on material placed in landfills. The municipality of Edmonton,

capital of Alberta, recently replaced its main landfill site with a comprehensive waste management process that aims for maximum recycling. It includes a composting facility for sewage and other suitable waste, as well as a gasification plant that produces commercial methanol (soon to be upgraded to produce ethanol). Interestingly, neighbouring municipalities do not use spare capacity in this plant: even with marketable output such as metals recovery, compost and methanol, waste processing charges are too high compared with the landfill alternative.

Agriculture

In agriculture, mitigation measures have mostly been via programmes funded under the federal/provincial/territorial agricultural policy frameworks that have been in place since 2002, such as the current "Growing Forward 2" (2013-18) framework. This supports research or helps finance practices that should reduce emissions, mainly of methane and nitrogen. These practices include improved manure storage, biodigesters, energy-use efficiency, cover crops, precision nutrient application, equipment for reduced tillage seeding and enhanced irrigation efficiency. Agricultural mitigation measures have also been funded through provincially-led emission reduction protocols for carbon offsets, such as in Alberta.

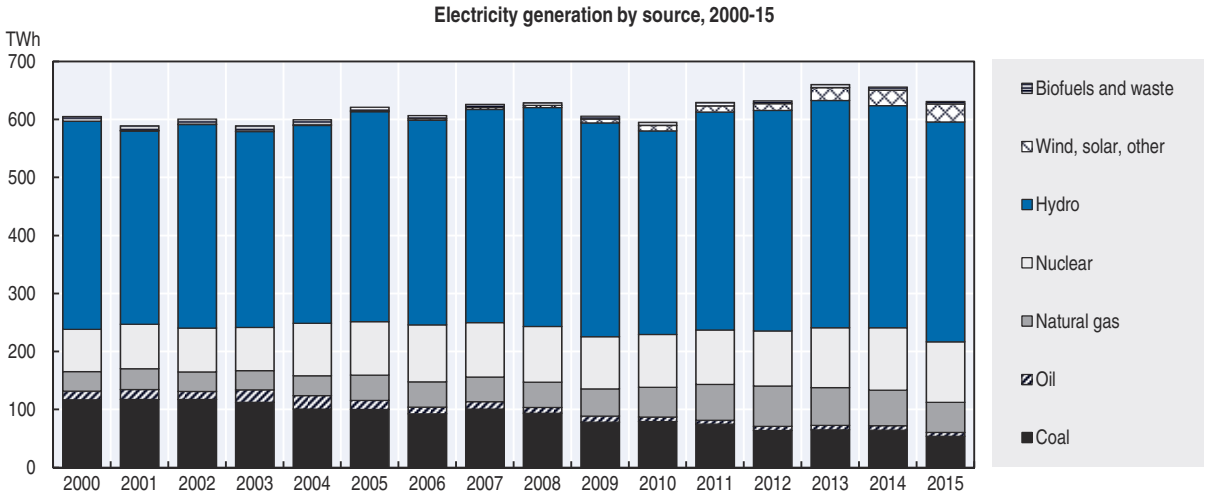
4. Mitigation in electricity generation[5]

Canada has one of the world's least carbon-intensive power sectors, due to a high share of hydro and nuclear power in the electricity generation mix (Figure 4.7). Hydropower accounts for 60% of total electricity generation. In absolute terms, only the People's Republic of China produced more hydro electricity than Canada in 2014 and 2015 (IEA, 2016). Over 2000-15, the share of electricity generated using coal and oil products decreased from 22% to 10%. This decline was partly due to a deliberate policy of reducing coal-fired capacity, notably in Ontario. Electricity generated from natural gas, nuclear and renewables (excluding hydro) have all increased over the same period. The most remarkable increase occurred in the wind sector, which boomed starting in the late 2000s. This boom increased the share of renewables (excluding hydro) in Canada's power generation sector from 1% to 6% over 2000-15 (Figure 4.7). Overall electricity output increased over this period by 4%, a slower rate of increase than either GDP or population growth.

The electricity generation mix varies a lot across Canada. In Quebec, Manitoba, Yukon, Newfoundland and Labrador hydropower accounts for almost 100% of electricity generation (Figure 4.8). British Columbia also relies primarily on hydro resources (86%). Following its phase-out of coal, Ontario's supply has been dominated by nuclear energy, which provides around 60% of total electricity generation, as well as hydro (24%) and natural gas (10%). Alberta, Nova Scotia and Saskatchewan generate more than half of their electricity from coal, although natural gas has an increasing role in Alberta and Saskatchewan. In small remote communities in the north, where grid electricity is not available because of lack of grid connections, communities use local diesel generators.

The Canadian electricity system is strongly integrated with the US interconnected systems. In 2016, Canada exported 74 Tera-watt hours (TWh), over 11% of domestic production, to the United States and imported 9 TWh. Trade in electricity with the United States is important in most provinces with most exports coming from Ontario and Quebec. The provinces of Saskatchewan and Alberta are net importers. There are far fewer east-west

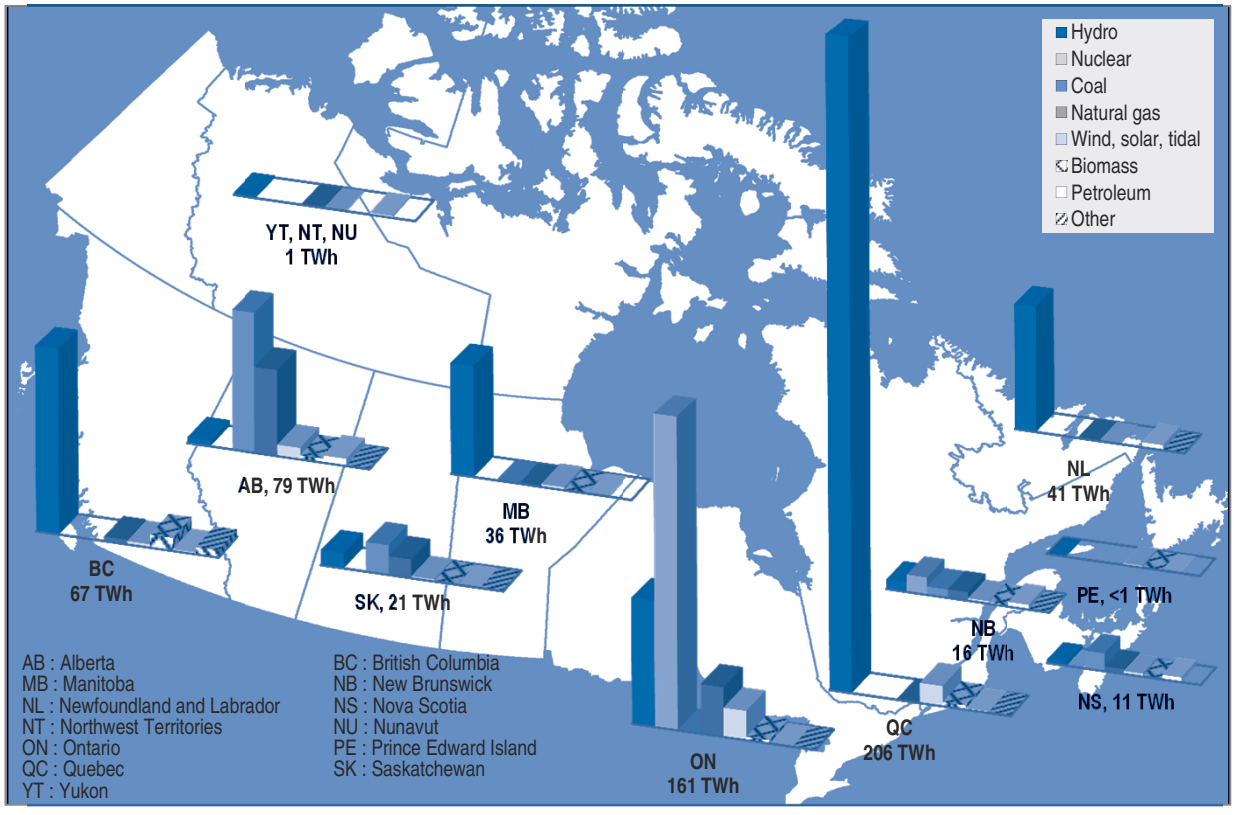
Figure 4.7. **Hydro continues to dominate electricity generation**



Source: IEA (2016), *IEA World Energy Statistics and Balances* (database).

StatLink http://dx.doi.org/10.1787/888933565830

Figure 4.8. **The electricity generation mix varies a lot across Canada**



Source: FAO GEONETWORK (2014), *Global Administrative Unit Layers (GAUL)*, *www.fao.org/geonetwork/srv/en/metadata.show?id=12691*; NEB (2016), *Canada's Energy Future 2016*; Statistics Canada (2017), CANSIM Table 127-0007.

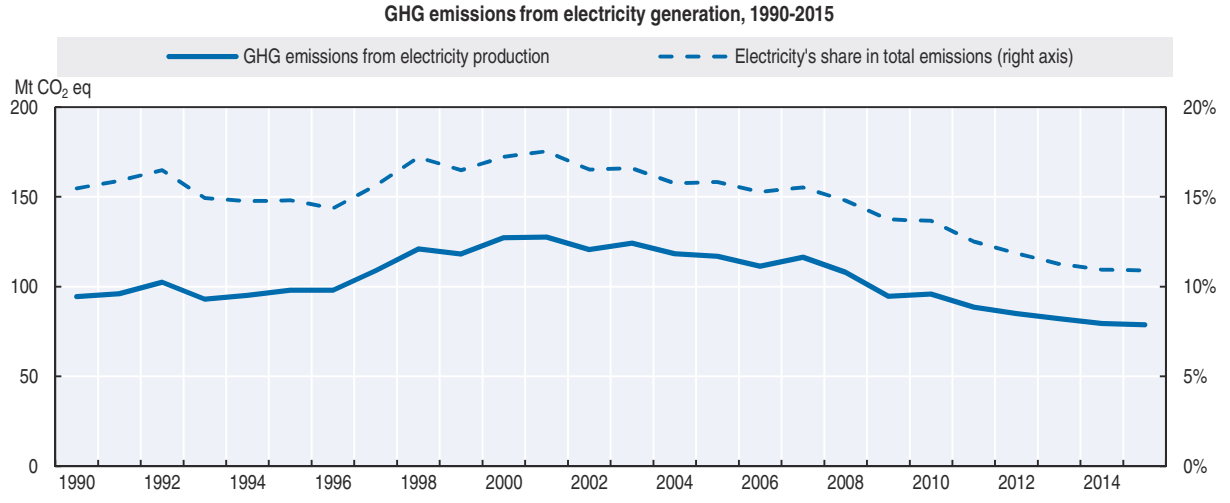
interconnections between the electricity transmission networks within Canada and, consequently, provinces and territories trade much less among themselves. This is largely a result of the large east-west distances between population centres in Canada (IEA, 2016).

Regulation of electricity markets varies widely across Canada. Most provinces and territories regulate wholesale electricity prices by a quasi-judicial board or commission. Exceptionally, Alberta has a competitive wholesale market. Ontario has a hybrid model of a partially open and partially regulated wholesale market and has announced a complementary capacity market. Ownership structures vary across the country although public (provincial or municipal) ownership predominates in most places – only Alberta, Nova Scotia and Prince Edward Island feature private ownership of their utility sector (IEA, 2016). The ownership structure may have been one reason why electricity generation has been at the centre of much emissions reduction in the past. Planning a coal phase-out in a sector dominated by public-owned vertically integrated companies, for example, may be easier to organise than under more competitive conditions. At the same time, however, Canada has plentiful renewable power resources, which offer good alternatives to fossil-based power generation.

4.1. *GHG emissions*

The shift in power generation from coal and oil products has led to a remarkable reduction in GHG emissions. Between 2000 and 2015, emissions from electricity production were reduced by 38% (48 Mt CO_2eq), far more than any other sector. The sector's share in total Canadian emissions declined from 17% to 7% in the same period (Figure 4.9). About two-thirds of these emissions come from coal-fired generation, followed by natural gas at 22% and refined petroleum at 6%. The absolute amounts of GHG emissions from diesel generators in the north are small compared with the rest of the country. Hence, Alberta, along with Saskatchewan, Nova Scotia and New Brunswick, account for most of Canada's GHG emissions from electricity generation.

Figure 4.9. **Electricity's share of total GHG emissions has declined**



Source: ECCC (2017), *National Inventory Report 1990-2015.*

StatLink http://dx.doi.org/10.1787/888933565849

4.2. *Current targets and policies*

In the past, policy objectives have varied widely among the provinces and territories, partly in line with their relative endowments of fossil fuels and hydro resources. More recently, especially after the Vancouver Declaration on Clean Growth and Climate Change,

they have started to converge. Proposed amendments to existing coal regulations will put Canada on a path towards 90% non-emitting generation by 2030, up from 80% in 2015. Electrification is expected to spread through the economy. In Canada's long-term strategy, electricity demand is expected to at least double by 2050, and low-carbon sources are expected to meet most of the demand.

Phasing out coal

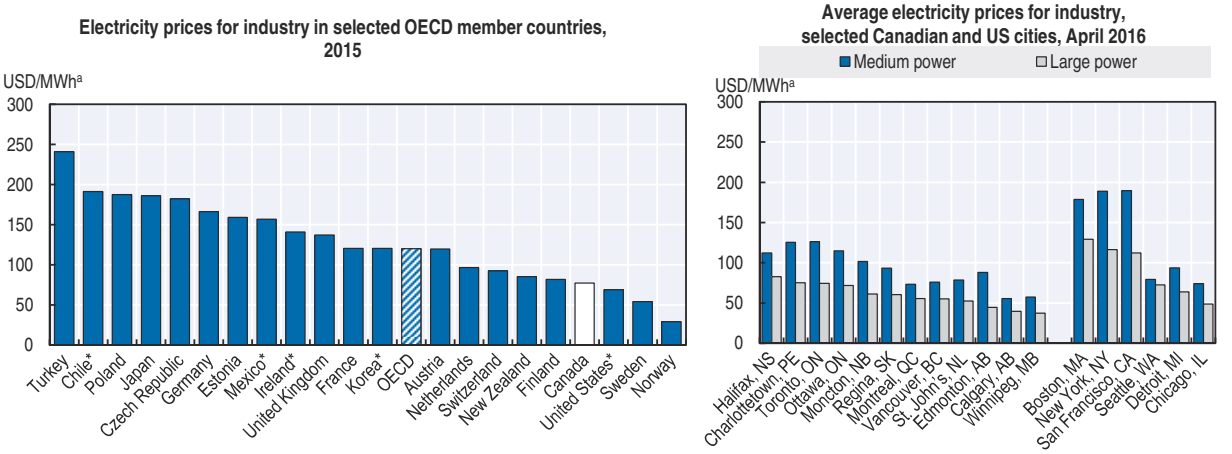
In 2012, the federal government published regulations limiting GHG emissions from regulated coal-fired generating plants to 420 tonnes of CO_2eq per GWh of net electricity generated, close to what can be achieved by Canadian natural gas combined cycle units. These regulations apply only to new plants (commissioned on or after 1 July 2017) and plants at the end of their design life (originally defined by the legislation as 50 years); emissions from existing plants not in those categories are not restricted, so as to reduce the cost of stranded assets. The government of Canada, as part of the PCF, is accelerating this phase-out of "traditional" coal-fired generation (the government expects plants operating with carbon capture and storage to be able to satisfy the emission limit) by applying the regulation to all plants in 2030, regardless of whether they have reached their design life.

Equivalency agreements are possible where provincial regulation provides for similar emission reductions. For example, Nova Scotia has implemented a mandatory declining cap on GHG emissions from Nova Scotia Power Inc. It started at an average of 9.6 Mt over 2010-11 to 7.5 Mt by 2020 and to 4.5 Mt in 2030. In June 2014, the Nova Scotia government and the Canadian federal government finalised an equivalency agreement on existing coal-fired electricity regulations. This allowed the federal government to suspend the application of coal-fired electricity regulations in Nova Scotia. A similar agreement may be reached with Saskatchewan.

Alberta reportedly produces more coal pollution than all other Canadian provinces combined (Alberta Government, 2017). It plans to replace all coal generation by 2030 – one-third by renewables and two-thirds by gas. This plan includes an Advisory Panel on Coal Communities to look for ways to ease the transition for workers and local economies affected by the rundown of mining and coal generation. It also provides for a coal phase-out facilitator to work with coal-fired electricity generators, the Alberta Electric System Operator and the government of Alberta to develop options for a phase-out by 2030 (Alberta Government, 2016).

Ontario's coal phase-out was partly facilitated by the ownership structure. This allowed all costs to be internalised in the publicly-owned electricity utility; Ontario's hydro capacity and its vicinity to Quebec's large hydro reserves should also help to contain costs. Even so, there have been recent complaints that the phase-out, and the parallel introduction of subsidies for renewables, induced an increase in prices. But there were other reasons for higher prices, including deferred grid infrastructure investment and nuclear refurbishment. In any case, international comparisons show the increase was very small compared with the large gap between electricity prices across Canada and those in the rest of the OECD outside North America (Figure 4.10). Alberta's fully market-oriented structure suggests that CO_2 pricing could be used rather than the case-by-case negotiations with coal-fired generator operators (to compensate for potentially stranded assets associated with a phase-out of coal-fired generation by 2030) that appear to be being used. As part of the accelerated coal phase-out, the federal government has proposed a flexible approach that would address concerns surrounding stranded assets through two key policies: i) allowing the conversion of coal boilers to run on natural gas; and ii) establishing agreements equivalency with provinces.

Figure 4.10. **Electricity prices in Canada are low**



Note: Data compare tariffs for one particular type of contract in each country, not the overall average cost of supply (for which data are not generally available). Prices are net of taxes except for the countries marked by an asterisk.
a) USD at 2010 prices and PPPs.
Source: IEA (2017), *IEA Energy Prices and Taxes Statistics* (database); Hydro Québec (2016), *Comparison of Electricity Prices in Major North American Cities*, April 2016.

StatLink http://dx.doi.org/10.1787/888933565868

The accelerated coal phase-out risks creating a new set of stranded assets in the form of new gas-fired plants. These are low-carbon by comparison with coal, but not compared with hydro and other renewable energy sources. They may not even be low-carbon compared with carbon capture and storage. The new gas-fired plants may therefore be obsolescent (because of the need to move to zero-carbon emissions) well before their design life is reached. This could mean both higher costs than intended and possibly higher GHG emissions, at least for a period. However, eliminating coal has other environmental benefits: coal combustion emits significant amounts of local air pollutants such as NO_x, SO_x and PM, which in turn cause smog and acid rain.

Carbon capture and storage

While some provinces are focusing on phasing out coal-fired power generation directly, Saskatchewan, a coal-rich province with few local alternative energy sources, invested in one of the world's first commercial-scale carbon captures on a coal-fired generating station. The Boundary Dam project retrofitted an existing coal-fired electricity generator near the US border. The facility has been operational since the end of 2014. The project's investment cost was about CAD 1.5 billion, about 6% of Saskatchewan's annual total fixed investment. The federal government provided a grant for about one-fifth of the total cost with SaskPower, a provincially-owned power utility, providing the rest. SaskPower (which aims to have 50% renewable electricity by 2030), is the vertically integrated principal provider of electricity generation, transmission and distribution services in the province. This probably makes this kind of investment less vulnerable to commercial risk than it would be in a more competitive regime.

Carbon capture and storage (CCS) is potentially a useful technology, if it is a viable low-cost option for meeting short-term targets and allowing more time for development of low-cost zero-carbon technologies. Until recently, there have been almost no full-scale examples of the technology in use, making it difficult to estimate the cost of using this technology compared with existing renewables, for example. However, Canada is now host to two large-

scale carbon capture, utilisation and storage facilities in two of the contexts where it might have most potential. One is the Boundary Dam facility in Saskatchewan in the power generation sector. The other is the Quest project in Alberta; this involves capturing CO_2 emitted during the conversion of bitumen extracted from oil sands into higher grade oils and injecting the extracted CO_2 into deep saline aquifers. Although both projects have been operating for over a year, publicly-available data do not, at the time of writing, permit calculation of parameters such as the GHG emission intensity of net electricity generated, or cost of operation, that could be compared with *ex ante* estimates (Box 4.2). Reliable data on the performance of Quest and the Boundary Dam project could be very useful, both in Canada and elsewhere. SaskPower and BHP Billiton of Australia have partnered to create the International CCS Knowledge Centre to advance carbon capture globally.

Box 4.2. **Carbon capture, utilisation and storage in Canada: Boundary Dam**

The Boundary Dam project retrofitted an existing coal-fired electricity generator with carbon capture. The captured CO_2 is not stored, but rather sold to a commercial company for enhanced oil recovery. The design called for 90% of emissions to be captured. On these conditions, *ex ante* estimates suggested the break-even price of carbon for the project was CAD 57 per tonne (PBO, 2016). Under the current contract, the captured gas is sold at around CAD 25 per tonne. A CO_2 price over CAD 32 (to be reached by 2020, according to the Pan Canadian Framework) would in theory make it viable. The main use for CO_2 in Canada could be for enhanced oil recovery in older conventional oil fields. Canada is also supporting innovation associated with the transformation of captured CO_2 into revenue- generating carbon-based products.

Without CCS, at a CO_2 price of over CAD 32, cost considerations alone would imply replacing coal generation with gas; hydro would be cheaper and wind might well be as well (PBO, 2016). If CCS became widespread, it might be difficult to market all the captured gas. Therefore, the cost of transport to storage locations and storage itself would have to be added to the break-even carbon price. PBO (2016) quotes an estimate of CAD 2 per 250 km for a large capacity pipeline.

SaskPower has suggested that experience acquired with the first installation would bring down capital costs and reduce the breakeven point to CAD 47 for a second installation; costs could be even lower on a newly-built generating facility rather than a retrofit (Saskpower estimates that such savings could be between 35% and 40%). SaskPower publishes data on CO_2 captured, but not its share of CO_2 generated, of coal consumption or of other related costs.

Support for renewables

A wide array of policies give different kinds of support to renewables from the provinces and territories (Table 4.3). Key direct incentives have been provided for electricity generation, some of which have been scaled back, notably feed-in tariffs (FITs). Ontario, for example, introduced a FIT scheme in 2009. Revisions in 2012 included lowering the subsidy for wind and solar energy. The FIT applied to solar photovoltaic generation, for example, fell by around 50% over 2012-17. However, it rose for various kinds of biogas about 50%, while FITs for small waterpower nearly doubled. Support still varies widely among the different technologies, though the range has narrowed.[6]

Table 4.3. **Provincial and territorial renewable energy policies and initiatives**

Province/territory	Renewable energy policy and measures
Alberta	• Alberta's Bioenergy Programs (2011-16) consisting of Bioenergy Producer Credit Program, Biorefining and Commercialization and Market Development Grant; and Infrastructure Development Grant Program 2007/08 to 2010/11 • Net billing for micro-generation • Coal Phase Out 2030 (incl. implementation and compensation [CAD 1.1 billion] agreement, Nov 2016) • Renewable Electricity Incentive Program • Alberta Indigenous Solar Program • Alberta Indigenous Community Energy Program • Clean electricity target of 30% of total generation from renewables by 2030 (approximately 5 000 MW additional) • Carbon levy and renewed SGER framework (CAD 20/tonne in 2017, CAD 30/tonne in 2018), including performance standards set for each industry starting in 2018. Funds raised by carbon levy are used for renewable electricity incentive programme and coal phase-out compensation
British Columbia	• Climate Leadership Plan (2016) with a target of 100% renewable energy by 2025, only allowing fossil fuels for reliability • BC Hydro's Standing Offer Program for clean energy resources up to 15 MW • Community Energy Leadership Program (CAD 1.3 M) • BC Hydro's Clean Power Calls (2006, 2008); Bioenergy Calls (2008, 2010); and Community-based Biomass Power Call (2010) • Net Metering Program (up to 100 kW) • All new electricity generation projects will have zero net GHG emissions • Innovative Clean Energy Fund Calls for Application (2008-10) of which 62 approved clean technology projects in bioenergy, solar, ocean, and energy conservation and management • BC Energy Play, Bioenergy Pal • Clean Energy Vehicle Incentive Program for vehicles and charging infrastructure • British Columbia is the only jurisdiction in Canada with both a renewable fuel requirement and a low-carbon fuel requirement • Renewable fuel standards, in place since 2010, mandate 10% reduction in the carbon content of fuels by 2020, 5% renewable content in gasoline and 4% in diesel • Potential electrification of upstream LNG production
Manitoba	• Clean Energy Strategy (2012) and Tomorrow Now; Manitoba's Green Plan (2012) outlines a target of 2.3 GW of new hydro and 1 GW of wind power • Climate Change and Green Economy Action Plan (2015) includes plan to implement cap-and-trade programme for large emitters, designed to link to similar programmes • Manitoba Green Energy Equipment Tax Credit • Residential Earth Power Loan Program • PowerSmart Solar Energy Program
New Brunswick	• Legislated RPS of 40% by 2020 • Net metering and embedded FIT for micro and small generators • Request for proposals for wind power • Will establish a "made-in-New Brunswick" price on carbon with caps on GHG emissions and proceeds directed to a dedicated climate change fund
Nova Scotia	• Legislated RPS of 40% renewable energy in the electricity mix by 2020 • Legislated caps on GHG emissions from the electricity sector (7.5 Mt 2020; 4.5 Mt 2030) • Enhanced net metering for distribution-connected customers • Community FIT programme for distribution-connected projects • Legislative framework for marine renewable energy • Tidal energy research and demonstration centre (FORCE) • Request for proposals for large-scale, transmission-connected projects • Solar for community buildings pilot programme • Discussion document outlining proposed elements of cap-and-trade programme • Provincial plan Our Electricity Future includes a focus on solar PV pilot projects and support for tidal energy research
Newfoundland and Labrador	• 98% of electricity will come from renewable energies with completion of Muskrat Falls in 2019 • Wind-diesel-storage hybrid systems in isolated areas to reduce diesel generation • Potential to further develop electric vehicle market and improve efficiency of heavy trucks under Climate Change Action Plan 2011 • The 2017 Net Metering Program allows electricity customers to generate power from small-scale renewable sources for their own use and to feed eventual surplus power into the distribution system
Northwest Territories	• Greenhouse Gas Strategy for the Northwest Territories 2011-15 set territorial goals to stabilise emissions at 2005 levels (1 500 kT) by 2015, then limit increases above this level to 66% by 2020, returning to 2005 levels by 2030. • Hydro, biomass and solar energy strategies • Renewable Energy Fund subsidises renewable energy generation
Nunavut	• Ikummatiit Territorial Energy Strategy (2007) focuses on alternative energy sources and efficient use of energy • Net-metering policy (<10kW) to be released in 2017 • Piloting of integration of small-scale solar PV in local electricity grids
Ontario	• Cap-and-trade system launched January 2017 • Feed-in tariff and microFIT programmes • Target of 10 700 MW of RES, wind, solar PV, biomass, excluding hydro, by 2018, and 50% renewable electricity capacity by 2025

Table 4.3. **Provincial and territorial renewable energy policies and initiatives** *(cont.)*

Province/territory	Renewable energy policy and measures
Prince Edward Island	• Home to the Wind Energy Institute of Canada (WEICan) • Since 2010, legislated RPS of 15% imposed on load-shifting utilities • Net metering for small energy producers
Quebec	• Cap-and-trade mechanism, linked with California (Western Climate Initiative) • 2030 Energy Policy: target to reduce petroleum products consumed by 40% (including diesel generation) • Quebec Energy Strategy (2006-15) outlines intended additions of 4.5 GW hydropower and 4 GW wind power capacity • Hydro-Québec Production mainly responsible for developing hydro facilities above 50 MW; Hydro-Québec tenders out wind and biomass capacity according to government orders and subject to approval by the regulator, la Régie de l'Énergie • Net metering for small producers • Hydro-Québec will install a total of 3.8 million smart meters by 2018 • Quebec Electric Circuit is Canada's first public charging stations network for electric vehicles (started in 2011), with 358 charging stations (2014) • Energy 2030 commits to increase renewable energy by 25% and increase production of bioenergy by 50%
Saskatchewan	• Target of 50% renewable capacity by 2030, and reducing electricity sector emissions by 40% below 2005 by 2030 • Renewables Roadmap for renewable procurement (solar, wind, hydro, geothermal) • SaskPower awards projects following requests for proposals • Net metering for small producers • Developed world's first CCS project fitted to coal-fired generating unit at Boundary Dam Unit 3 • The province has set a target that 50% of its electricity will come from renewable sources by 2030, up from about 25% at present
Yukon	• Biomass Energy Strategy (2016) • Micro-generation programmes (<25 kW) and independent power productions programmes • Target to increase supply of renewable energy by 20% by 2020 • In 2009, the Climate Change Action Plan was released. The 2015 progress report contained 28 specific actions including increased use of renewable fuel sources where appropriate.

Note: FIT = feed-in tariff; RES = renewable energy sources; RPS = renewable portfolio standards.
Source: IEA (2016).

4.3. *Expanding electricity generation*

More renewables are needed

Continued increases in demand for electricity can be expected. Even without the PCF, the National Energy Board (NEB) already projects an increase in electricity generation of 10% or more between 2015 and 2030, with gas supplying most of this increase. Achieving the PCF targets will imply increasing electrification of the economy as industry and households are encouraged to switch to low-carbon technologies. Much of this will have to be emission-free, either from hydropower or other renewables. In the NEB's projections to 2040, made before the PCF was in place, the share of non-hydro renewables in capacity was projected to rise from about 10% to 16% (although its share in actual generation would be only 8%). Although hydro generation would increase by nearly 20%, its share in total generation would fall slightly. In this reference scenario, recent sharp increases in non-hydro renewables (notably in wind power) do not continue for long. This is because provinces, which have been active in promoting renewables, have phased out some of the stronger incentives.

Additional generation capacity required to meet future demand needs to be developed in ways that minimise environmental costs while ensuring reliable energy supplies across the country at reasonable cost. The cheapest solution in most cases and in most places, with current technology, might be to expand hydropower. For example, in 2013, Ontario paid nearly four times less to produce electricity with hydro than using gas. Hydro was also 60% cheaper than wind and 30% cheaper than nuclear. However, this does not take account of the full costs, both current and capital. Some of the physical capital required needs renewing and the current prices charged for hydro and nuclear energy are reported to be insufficient to finance renewal (PBO, 2016).

The US Energy Information Administration (EIA) has calculated estimates of the levelised cost of electricity generation for new installations in 2020 under various technologies. These estimates show hydro electricity as somewhat more costly than natural gas and coal (with pollution control technology, but no carbon price). But it also shows wind power to be competitive with natural gas (PBO, 2016). With the carbon price planned under the PCF, both hydro electricity and wind would thus be strongly competitive.

If the EIA calculations are correct, and broadly apply in Canada as well as the United States, it would seem there should be a lot of investment in either wind power or hydropower to help decarbonise the economy. This builds a strong case for phasing out direct support policies for renewables, and relying on pricing GHG emissions and other externalities of non-renewable energy. This, in turn, would result in more cost-effective solutions, releasing resources (including administrative resources in both public administration and in energy suppliers) that could be used towards environmental goals where use of market mechanisms is more problematic. Provinces that nevertheless want additional programmes to encourage the use of renewables in electricity generation should avoid committing to any future level of subsidy in advance. Rather, potential suppliers can be invited to bid for subsidies for a certain amount of capacity and/or delivered electricity; California introduced such a mechanism in 2010.

The regulation of electricity prices and the publicly-owned nature of suppliers in many jurisdictions may make carbon pricing less effective as a GHG mitigation strategy than it otherwise might be. Regulators will have to decide how much of the carbon price is borne by consumers and how much by producers. Provided public ownership does not insulate electricity suppliers from the need to make satisfactory financial returns, they will have internal incentives to find least-cost solutions from competing technologies to the need to cut GHG emissions. Competition between alternative suppliers to wholesale markets, however, will not be part of that mechanism.

Improved inter-connections between the different Canadian electricity markets could increase competition, which would in turn accelerate the transition to low-carbon electricity. It could also potentially reduce overall electricity costs and increase resilience. But there is no formal co-operation between the provinces on transmission and resource planning. In fact, inter-provincial power trade would also face a number of practical difficulties. All provinces have one transmission system operator and there are no harmonised rules for inter-provincial electricity trade across Canada (IEA, 2016).

Wind and solar power require investment in storage or backup facilities to cope with the inherent variability of these sources. Canada's extensive hydro-electricity generation capacity, with large reservoirs, puts it in a good position to manage variability of wind and solar power.[7] Manitoba Hydro already exports hydro electricity to Minnesota and North Dakota in the United States to balance wind variability in these states. However, good sites for new hydro generation and wind will not always be found close to where the energy is needed. This will require substantial investment in long-distance high capacity transmission lines, including in better grid connection to allow for trade across provinces. Provinces such as Alberta and Saskatchewan, which have been self-sufficient in energy, may find themselves net importers of hydro. Wind and solar will require complementary investment in smart networks, switching, new storage technologies and in-demand management.

In addition, contract structures need to be re-thought to ensure that suppliers have the right incentives. A large share of capacity with low marginal cost, but high capital costs

and intermittent availability, changes the economics of supply. The Alberta Electricity System Operator has reviewed the Alberta electricity market that sets out how to address these issues (Box 4.3).

Box 4.3. **Electricity market modernisation in Alberta: Supporting the transition to cleaner energy**

Over the next 14 years, Alberta will close 18 coal-fired power stations. It will require up to an estimated CAD 25 billion of new investment in electricity generation to support the transition towards cleaner sources of energy and meet the electricity needs of a growing province. In response, the Alberta Electricity System Operator has reviewed the province's electricity market to determine what market structure would best support this transition while maintaining reliability at reasonable cost.

Alberta has an energy-only electricity market where generators make bids to dispatch electricity into a "pool". Lowest-cost generators are dispatched first; the more expensive ones are brought in as needed to handle higher demand. Generators are paid based on the price of the last generator dispatched. In such a market, investors rely on the volatility of the market to send price signals for new investment. Low prices can indicate an abundance of generation capacity, while high prices can indicate a tighter supply of generation. Investors create an outlook of future electricity prices under a range of conditions. These forecasts are critical inputs for determining whether to invest in new generation.

The review sought to understand how adding greater intermittent renewable generation (such as wind) would affect pool prices for electricity, as well as revenues available to support investment needed to ensure a reliable supply of electricity (i.e. new "firm generation"). Because operating costs of intermittent generation are low (i.e. wind and sun are free), this reduces the pool price for electricity. This, in turn, reduces revenue for competing generators, making them more reliant on higher prices at times when intermittent generation is producing less or not at all. The review found considerable uncertainty about whether sufficient investment in firm generation will occur in the future due to both reduced revenues available in the market and reduced interest in investing in energy-only markets where revenue is uncertain.

To address this, the Alberta Electricity System Operator has recommended transitioning from an energy-only market to a capacity market, a recommendation endorsed by the provincial government. A capacity market has two separate markets. In the first, generators compete to sell their electricity; in the second, generators compete for payments to keep generation capacity available to produce electricity when required. A capacity market solves the price impact problem created by intermittent renewable generation by giving value to the important attribute of supply certainty. This value, in the form of a capacity contract, helps offset the effect of increased levels of intermittent generation, depressing energy prices and reducing available revenue.

Encouraging energy saving

Smart networks can help short-term demand management. Notably, intermittent wind power can be partially matched to interruptible supply contracts (some electricity users are willing to pay less in return for having their supply interrupted at times of peak demand or drops in supply). An intelligent network can forecast drops in wind power, notify and switch out those customers. This may not save overall energy consumption, but it can reduce the overall capacity required.

Other forms of demand management are already used in Canada. For example, New Brunswick (2005, 2014) introduced regulations to promote energy efficiency, including specific targets for some sectors. Yukon (2009) issued targets for energy efficiency and GHG intensity in government buildings and operations; this included an objective of working towards becoming carbon neutral by 2020. Price is one key measure that – arguably – is not used. Especially in jurisdictions where generation and supply are publicly owned, the level of prices may be too low to generate the revenue needed for future investment. Increasing prices would be unpopular, but would both help to finance the necessary investment and limit the growth in demand. Conversely, maintaining too-low prices results in too much consumption and over-investment in capacity (because a public sector provider is obliged to install capacity to meet the inflated demand). This diverts resources from other uses and likely leads to additional public debt as well. Canada's low energy prices are a key competitive advantage. However, they should be based on genuine resource availability, not under-pricing of externalities, implicit subsidies or skimping on infrastructure maintenance and investment. The PCF's overarching strategy of establishing an economy-wide price for CO_2 emissions is, in part, a recognition of this.

Policies such as labelling schemes, or encouragement for energy audits, can be useful in increasing sensitivity to prices and reductions in demand. An internal evaluation report of Natural Resources Canada's Energy Efficiency Programs (covering 2009-14) appears very encouraging for current policy, notably labelling and information schemes (NRCan, 2015).[8] There is increasing attention paid to ways in which it can be stimulated such as by appealing to people's concern for what the neighbours think (Box 4.4). Information schemes, such as ENERGY STAR labelling, are not costly to run. Their continuance, aligned as far as possible with labelling in the United States, is a useful part of the PCF.[9] Most of these schemes are part of Natural Resources Canada's ecoENERGY Efficiency programme. This is a wide-ranging scheme, which also encourages and/or subsidises energy-saving investments (a number of which have been discontinued), especially in housing; it has evolved over the last decade.

Box 4.4. **Electricity consumption: What about the neighbours?**

Two Ontario power companies have recently implemented a billing scheme imitating a successful programme in the United States. In this initiative, home energy bills sent to customers compared their energy consumption with that of their immediate neighbours.

In the US trial, based on controlled randomisation, people did not react very much to information about their consumption relative to that of the overall population. However, they were quite sensitive to that of people in their neighbourhood (Allcott, 2011). Households who saw that in one period they had consumed well above average showed a distinct tendency to reduce their consumption in following periods. The overall effect was not large – a reduction of about 2% in consumption – but this was estimated to be equivalent to the short-run impact of an 11% rise in price. The study also found that households with comparatively low consumption tended to increase subsequent consumption. This effect was much reduced, however, by the addition of simple "smiley"-like signs to reinforce the idea that low consumption was a desirable achievement.

Another study looked at how time-of-use (TOU) pricing for electricity could be improved as an effective means to allocate electricity. Martin and River (2015) evaluates a large-scale field trial in which households facing TOU pricing were given an in-home display, providing real-time feedback on electricity consumption. Receipt of the device results in a

Box 4.4. **Electricity consumption: What about the neighbours?** *(cont.)*

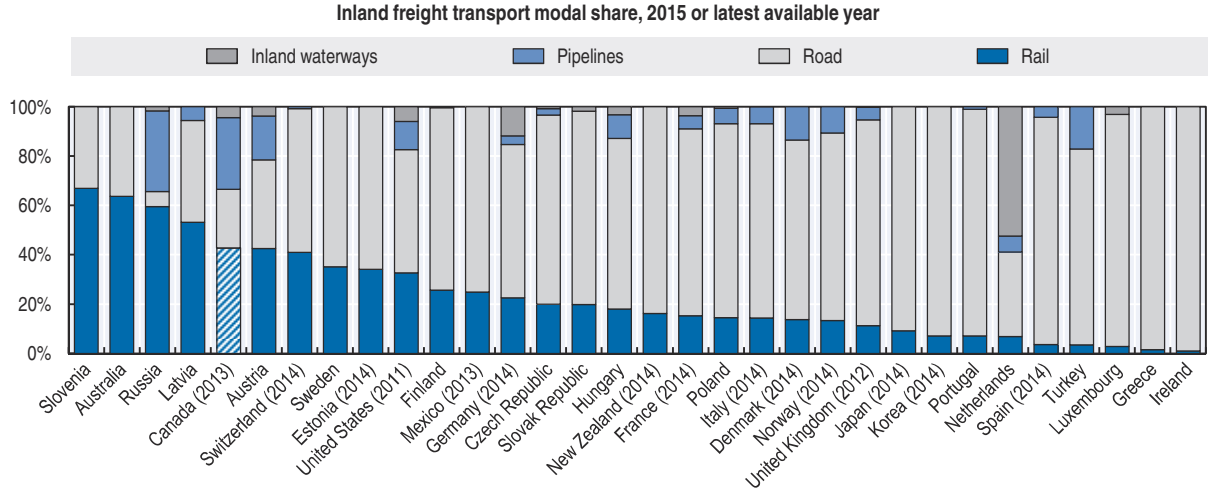
3% reduction in average electricity consumption. The reduction in demand is roughly constant throughout the day, concentrated in the fall and winter. It is sustained for at least five months following receipt of the device, with households becoming more (less) price sensitive in warmer (colder) months.

Further analysis of these and other such schemes, including whether the effects continue in the longer term, could help understand how best to combine pricing signals and "nudging" policies. Examples from many countries and in many different policy domains can be found in OECD (2017b). OECD (2017c) discusses the issues specific to environmental policies.

5. Mitigation in the transport sector

Canada's vast landscape, which entails long distances between the main economic centres, combined with historically low fuel prices, means that transport is an important sector of the economy. Canada generates more road and rail freight transport (measured by tonne-kilometres) both per unit GDP and per capita than almost any other country in the OECD. Dispersed settlement patterns and low density urban structure make passenger transport a necessity rather than a luxury. Roads are by far the dominant mode for passenger transport. By contrast, a relatively small share of freight is transported via roads (Figure 4.11). As nearly all transport uses hydrocarbon fuels, GHG-intensity is high as well. Transport-related CO_2 emissions, on a per capita basis, are the third highest in the OECD, after Luxembourg and the United States (IEA, 2017).

Figure 4.11. **Canada has a high share of rail freight**



Note: Based on data expressed in tonne-km, data on inland waterways for the United States include missing data.
Source: ITF (2017), "Goods Transport", *Transport Statistcs* (database).

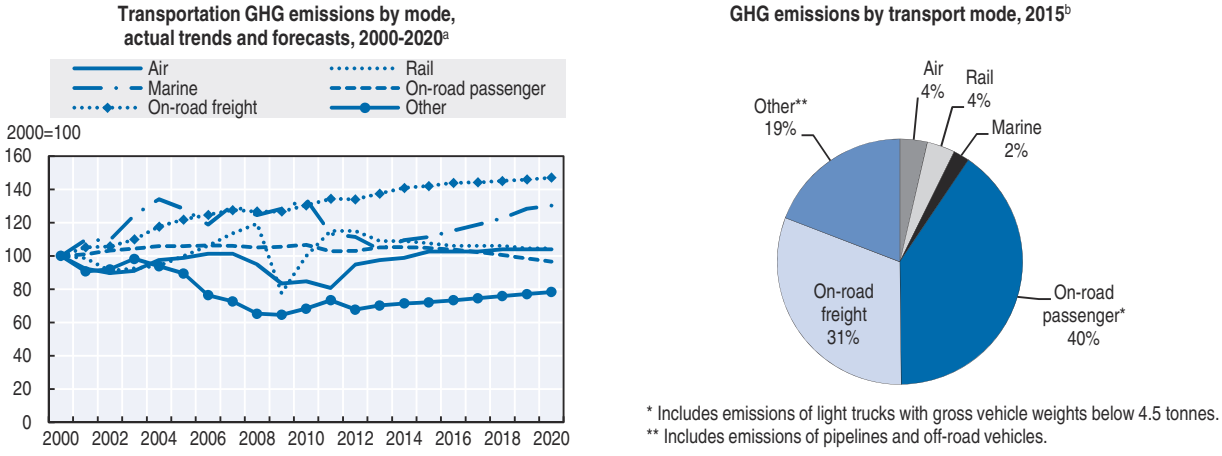
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5.1. *GHG emissions*

Transport contributed 24%[10] of Canada's GHG emissions in 2015, similar to oil and gas extraction and more than twice as much as electricity generation (ECCC, 2017). Only Switzerland, Sweden, Slovenia, Austria and France, all countries with relatively low-emission

electricity like Canada, have a higher share of emissions from transport.[11] Since 2000, emissions from transport rose by 21 Mt CO_2eq (or 14%), an increase nearly as large as that of the oil and gas industry. This increase was mostly driven by on-road freight transport (which increased by more than 40% over 2000-15). Emissions from on-road passenger transport, rail, domestic aviation and marine transport also increased between 2005 and 2015, albeit at a much slower rate (Figure 4.12). Government projections are that GHG emissions from the on-road passenger transport sector are likely to decrease up to 2030 as a result of existing regulations and despite increases in distances travelled. Freight transport emissions, by contrast, are expected to continue increasing, exceeding passenger transport emissions in 2030 (ECCC, 2016).

Figure 4.12. **Road passenger transport generates most of the sector's GHG emissions**



a) 2014-20 data are based on projections from Transport Canada.
b) According to the 2017 National Inventory Report.
Source: ECCC (2017), *National Inventory Report 1990-2015 - Part 3*; Transport Canada (2016), *Transportation in Canada 2015 - Statistical addendum 2015.*

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Road transport accounts for almost three-quarters of the transport sector's emissions. In Canada as a whole, about 60% of road emissions are from private passenger transport and 40% from light and heavy duty trucks and buses. However, this varies by province; in Alberta, for example, more than half of emissions are from freight. GHG emissions from road transport (including both passenger and freight) are about 17 times higher than those from railway traffic, domestic aviation, or lake and river transport – despite a relatively large role of rail for freight transport in Canada (Figures 4.11 and 4.12). Heavy trucks alone emit six times as much as all railway traffic. The main potential for reducing emissions from transport is thus likely to be in reducing the GHG intensity of road transport and/or shifting substantial amounts of traffic away from road. A modal shift is likely to require substantial infrastructure investment. In 2013, public investment on transport infrastructure was nearly CAD 30 billion, about 10% of Canada's total fixed investment; 80% was on roads (Transport Canada, 2016a).

GHG emissions from the rail sector have been rising much less than the raw increase in traffic: emissions increased by 8.5% over 2000-13 compared to an increase of 29% in tonne-kilometres transported (Transport Canada, 2011, 2016b). As for road traffic, no such reduction in GHG intensity has been seen for freight and not much for passengers. GHG emissions from road freight transportation increased by 37% between 2000-13, and

passenger traffic by 5%. Over the same period, road freight traffic volume increased by 37%, and passengers-kilometres by 17%. As short journeys declined, compositional changes may explain part of the improvement in emissions from rail freight. However, it seems there has been a stronger underlying improvement in rail than in road.

A modal shift?

As GHG emissions per tonne-kilometre from rail are much lower than from road, a rising carbon price will induce some modal shifting. This could be accentuated if railways were electrified (diesel locomotives supply almost all motive power). However, Transport Canada focuses on a steady reduction in the emission intensity of diesel-powered rail transport. Because road transport is much more flexible than rail, the extent to which prices can induce a shift may not be very large. There is a substantial implicit subsidy to road compared with rail because the public sector provides most road infrastructure whereas rail users typically pay infrastructure costs as well. But rail is exempted from most fuel taxes (which, for road fuels, were originally conceived as a way to finance road infrastructure). Therefore, it is not clear whether roads are more subsidised than rail. Nevertheless, many arguments favour increasing the direct charge to road users to pay for infrastructure use. But although road-charging is gradually spreading in different parts of the world, it is rare in Canada; a recent attempt to introduce road pricing – the introduction of a toll on two urban highways by the Toronto municipality – was vetoed by the Ontario government.

Modal shifts can be difficult to achieve. In most cases, flexibility and low transhipment costs for final delivery are important considerations. Thus reducing the high energy intensity, and therefore the high emissions intensity, of transport in Canada will rely a lot on cutting emissions from road transport. This can happen through improved efficiency and restraining the demand for travel. Canadians are used to low fuel prices, low-density housing settlements and, in many places, little provision of public transport. All of these factors contribute to high energy use in private transport. Nevertheless, it is encouraging that distance travelled in private automobiles seems to have stabilised since 2000 despite continued growth in GDP. But the possible contribution of a modal shift should not be overlooked.

Investment in rail infrastructure that could increase its share of traffic should be subject to cost-benefit analysis using an implicit price for carbon that should be quite high, given the long-lasting nature of such investment and its road-based alternatives. A cost-benefit analysis of a possible high-speed rail link in the Quebec City–Windsor corridor showed the project was economically infeasible, with an imputed cost for CO_2 emissions of CAD 40 per tonne (Transport Canada, 2016c). Over the lifetime of the project, the minimum price will be at least CAD 50 and possibly much higher. Therefore, a higher imputed cost of CO_2 emissions would be logical and might deliver a different verdict on the electrically-powered option. It is encouraging that such projects undergo this kind of cost-benefit analysis, provided the environmental costs and benefits are fully taken into account.

5.2. Policies to reduce emissions in road transport

Reducing GHG emissions in road transport can be done in two broad ways: reducing distance travelled per vehicle and reducing emissions per distance travelled. In turn, these can be split into two methods: reducing distance travelled by cutting transport demand or by shifting to mass transit; and reducing emission per distance travelled by reducing emissions per vehicle or (again) by switching to mass transit. Though a modal shift may

help, most GHG reduction in transport needs to come from reduced emission intensity within the different modes.

In some cases, the impact of policies on total GHG emissions is not obvious, as intermediate objectives are affected in opposite directions. For example, subsidies for public transport, or for fuel- efficient vehicles, do induce a switch towards lower emissions for any given distance travelled. However, they also reduce the costs of transport and so potentially increase overall travel, other things being equal. It is unlikely, but possible, that overall emissions could thereby increase, especially if public transport provision is inefficient or not very low emission. If policies are not co-ordinated, increases in overall traffic can potentially worsen environmental or other external costs of transport, even if GHG emissions fall.

Federal road transport policies

Fuel taxation is one of the most obvious measures to improve fuel economy. Taxes are levied at both the federal and provincial levels. Federal fuel taxes are among the lowest in the OECD, though higher than in the United States; provincial taxes are typically higher (see Chapter 3). In most jurisdictions, the tax on diesel fuel used in railway locomotives and other railway equipment is only one-third the level of the combined standard rate, as most provinces and territories levy much lower rates than on fuel for road use. Aviation fuel, too, is taxed at a much lower rate than road fuel, although the rate has almost doubled over 2014-17. The inclusion of transport fuel in Quebec's cap-and-trade system increases its effective rate.

The most important transport-specific mitigation measures in place are regulations on light-duty and heavy-duty vehicles. There are separate regulations for off-road and on-road vehicles. For light-duty vehicles, Canada's regulations are the same as in the United States and Mexico. They set GHG/fuel economy target values[12] based on vehicle footprint, calculated as wheelbase multiplied by average track width. The overall standard for a specific manufacturer is determined by averaging the targets for the footprints of all vehicles produced by the manufacturer. They were introduced in Canada in 2010 to cover model years from 2011 onwards. However, even before this date, US standards strongly influenced developments in Canada because of the integrated automobile market in North America. In 2016, the average light-duty vehicle sold should have had GHG emissions intensity of 135 g/km. By 2025, average emissions per kilometre for light vehicles are intended to be 98 g/km; this will be 50% less than in 2008 (compared with a reduction of 23% for heavy-duty on-road vehicles). For heavy-duty vehicles in Canada and the United States, smaller vehicles are subject to a fleet average footprint based standard, while larger heavy-duty vehicles and engines are subject to conventional standards (not footprint based).

The regulations are quite complicated. For light-duty vehicles, there are different formulas used to calculate the GHG emission target value for a vehicle. For each car or light truck, the target value is then determined by the vehicles' footprint on the road. The standards also include features to give incentives for innovation. For example, zero emission light duty vehicles (electric and fuel cell) and very low emission vehicles (plug-in hybrids, natural-gas fuelled) have a higher weight in the average. For example, an electric light duty vehicle sold in 2017 counts for 2.5 vehicles. However, recognising the risks of excessive costs, this advantage will be phased out over time (the multiplier is to be reduced to 1.5 by 2022). Additional allowances are available for "innovative technologies". Smaller heavy-duty vehicles follow a similar methodology to establish target values based on the vehicle's footprint and weight class.[13]

In private road transport, vehicle emission standards appear to have been effective in improving fuel economy and reducing emissions for each type of vehicle. However, these effects have been partly undermined by purchasers shifting towards increased use of light trucks (pickups, minivans and sport utility vehicles) within the "light-duty vehicle" class at the expense of cars (Table 4.4). This switch towards light trucks in itself is not the main reason for the increasing emissions from road traffic. On its own, it would have increased GHG emissions by about 10% between 1990 and 2014. The combined effects of improved fuel efficiency within each class of vehicle, and better emissions control, would have more than offset the increased emissions. The chief culprit is the increased number of vehicles (itself only partly offset by a fall in the distance travelled per vehicle) (Figure 4.13). These adverse trends were more moderate in the period after 2005, allowing a small fall in overall light vehicle emissions.

Table 4.4. **Number of light- and heavy-duty vehicles in Canada**

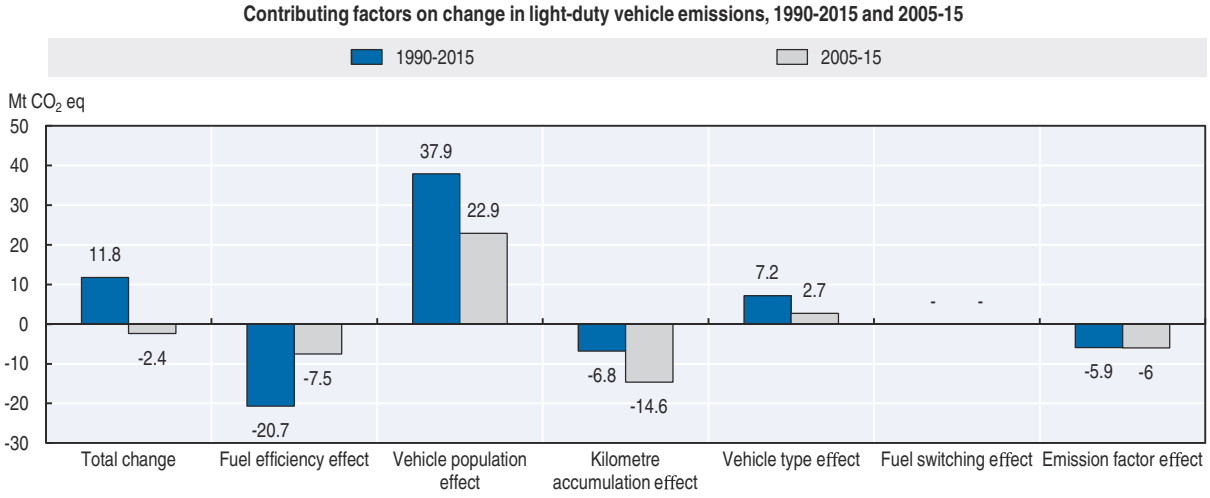
	Number of vehicles (000s)			
	Light-duty vehicles		Heavy-duty vehicles	All vehicles
	Cars	*Trucks*		
1990	10 755	3 371	968	15 410
2005	11 008	6 877	1 690	20 072
2009	11 995	8 556	2 129	23 274
2010	12 014	8 919	2 155	23 720
2011	11 909	9 272	2 142	23 961
2012	11 894	9 622	2 268	24 451
2013	12 269	10 238	2 360	25 543
2014	12 299	10 766	2 421	26 190
2015	12 381	11 238	2 469	26 808
Change since 1990	**14%**	**204%**	**144%**	**66%**
Change since 2005	**8%**	**35%**	**27%**	**19%**

Note: Light-duty trucks include most pickups, minivans and sport utility vehicles. All vehicles also include motorcycles and natural gas and propane vehicles.
Source: Canada (2017), Table 2-6.

The GHG emission regulations are reinforced by fuel economy information programmes, notably the EnerGuide Label for Vehicles and the Fuel Consumption Guide. EnerGuide labels are similar to electrical appliance labelling. They give information on average fuel consumption and typical expenditure on fuel, showing how the vehicle compares with the range available on the market. The Fuel Consumption Guide is an online service for checking the average fuel consumption of any make and model of automobile.

For heavy goods vehicles, the objectives in emission reductions are apparently less ambitious than for light vehicles. This is perhaps because truck fleet operators already have strong commercial incentives to keep fuel consumption down. Nevertheless, some evidence suggests that gains in fuel efficiency forced by the US CAFE standards for light vehicles are transferable at least to the lighter end of the freight vehicle fleets; thus, they could perhaps be more ambitious (Lutsey, 2015). There are, however, training programmes for commercial truck drivers that can show driving styles that are more fuel efficient. Canada adopted the US SmartWay Program in 2012, which is a public private partnership to help businesses reduce fuel use while transporting goods in the cleanest, most efficient way possible. In 2017, the programme was expanded to Mexico to ensure a continental approach to greening freight by

Figure 4.13. **Rising use of road vehicles drives emissions increases, despite technical improvements**



Notes: Total GHG emissions by light-duty vehicles were 1990: 68 Mt CO_2 eq (46 cars, 22 trucks), 2005: 83 (43 cars, 40 trucks), 2015: 80 (35 cars, 45 trucks).
Total change is the difference in total emissions over the selected time periods, 1990–2015 and 2005–15.
Fuel efficiency effect: change in emissions due to the change in fuel consumption ratios (expressed as litres/100 km).
Vehicle population effect: change in emissions attributable to the change in the total number of light cars and trucks on Canadian roads.
Kilometre accumulation effect: change in emissions due to average annual driving rates.
Vehicle type effect: change in emissions due to the shift between different vehicle types (e.g. cars and trucks).
Fuel switching effect: change in emissions due to the shift between fuels (e.g. motor gasoline vs. diesel fuel).
Overall emission factor effect: change in emissions from emission control technologies on CH_4 and N_2O emissions, as well as the use of biofuels.
Source: ECCC (2017), *National Inventory Report 1990-2015.*

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sharing best practices and benchmarking the energy used in the movement of goods across North America.

In addition to vehicle-focused policies, Canada has also had, since 2010, an "alternative fuels" programme. Under this programme, at least 5% of gasoline and 2% of diesel or heating oil should be from renewable fuels. This largely means ethanol, much of which is imported. Biofuel usage has increased over the past decade, thanks to the federal alternative fuels regulation. Production subsidies through the ecoENERGY for Biofuels programme for biofuel producers have also helped increase usage (IEA, 2016).

The government plans to modify these regulations into a "clean fuel standard", which would take more care to look at the "life-cycle" of GHG emissions. Current requirements could be satisfied in principle by using ethanol whose production and transport to Canada may have emitted more GHGs than the fossil fuel it replaces.

Some provinces run programmes to encourage electric vehicle (EV) purchases. Quebec, for example, intends to have 100 000 electric vehicles and plug-in hybrids on its roads by 2020. It subsidises the purchase of EVs with up to CAD 8 000 (roughly 20% of average purchasing prices). It also subsidises the purchase and installation of charging stations, both at home and at work. The subsidy is financed through the Green Fund, whose revenue derives mainly from the carbon market. Ontario and British Columbia have similar programmes, with subsidies of up to CAD 14 000 and CAD 5 000, respectively, for the purchase of EVs. Some provinces use additional incentives, such as allowing EVs to use high-occupancy vehicle or toll lanes (Plug'n Drive, 2017).

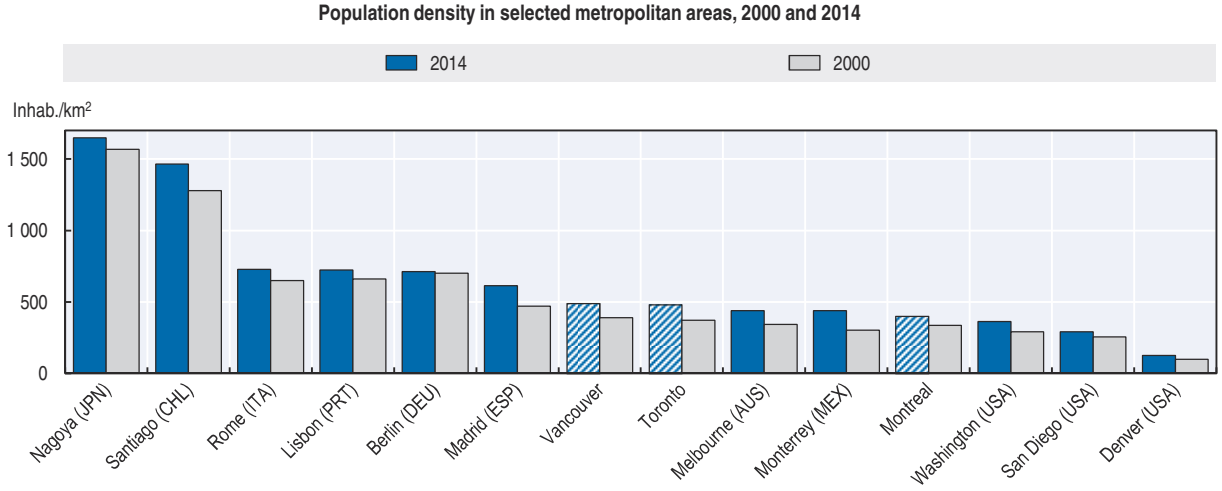
Most provinces have programmes seeking to improve public transportation. These include Alberta's GreenTRiP programme and Ontario's The Big Move: Transforming

Transportation in the Greater Toronto and Hamilton Area. The Ontario programme aims at a long-term sustainable transportation plan for one of Canada's largest urban areas, increasing the use of transit and cycling in the region.

Land use, urban planning and smart cities

Urban transport policy is challenging in Canada, given the low population density in most cities (Figure 4.14). Little attention has been given to fuel use or climate change issues in planning urban development in Canada, yet interest in better planning is growing. "Transit Oriented Developments" emphasise high density planning in close proximity to transit stations, transit priority measures within the community and rapid transit routes to employment centres. According to the Victoria Transport Policy Institute, residents in these developments tend to own 15% to 30% fewer vehicles, drive 20% to 40% fewer annual kilometres and rely more on walking, cycling and public transit than they would in automobile-dependent communities (CUTA, 2016; VTPI, 2017).

Figure 4.14. **Canadian cities feature low population density**



Source: OECD (2017), *OECD Regional Statistics* (database).

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An apparently mundane, but in fact quite significant aspect of urban planning, is parking policy. It can have an important influence on both use and ownership of automobiles, especially when integrated with policy on public transport. A number of Canadian cities are trying different approaches to make parking policy more consistent with urban policy goals (Box 4.5).

Box 4.5. **Urban planning: Using parking policy to promote sustainability**

In many Canadian cities, as with most cities in North America, parking policy has been structured largely around promoting increases in parking supply to meet projected demand. To that end, new developments are often required to include a minimum number of parking spaces per dwelling unit or office space, for example. However, such minimum parking requirements subsidise car use at the expense of other transportation modes, reducing urban density, increasing construction costs and promoting increased driving. Moreover,

Box 4.5. **Urban planning: Using parking policy to promote sustainability** *(cont.)*

street parking is often unpriced, even in very dense neighbourhoods with limited available parking. The resulting scarcity of free spaces can lead to extensive "cruising" for parking spaces. This has been shown to cause a significant percentage of the traffic in many congested urban neighbourhoods (Shoup, 1999; Litman, 2016).

A number of Canadian cities are reforming parking policy to make it more consistent with municipal goals beyond parking supply. For instance, the Borough of Saint-Laurent in the city of Montreal put new parking regulations into effect in 2010. Among other goals, they aimed to reduce heat islands and other environmental impacts caused by parking areas. The new regulations favoured public transit, as well as walking and biking, and promoted urban density (Borough of Saint-Laurent, 2011). They significantly reduced the number of spaces required for specific uses. For the first time, the borough capped the number of allowed spaces per property at 150% of the maximum. Perhaps most importantly, the new regulations adapted parking requirements to individual neighbourhood conditions. Specifically, they reduced the number of required spaces by 40% in the densely-populated Vieux-Saint-Laurent neighbourhood, and by 20% in areas close to existing commuter train stations and projected metro stations.

More recently, Montreal has adopted a city-wide parking policy that includes many elements of Saint-Laurent's regulation, and that seeks to free up land devoted to parking for other uses. This policy also promotes approaches that allow for "pooling" of parking required in a neighbourhood, rather than requiring each development to have its own dedicated parking spots. It encourages the deployment of technology to maximise access to existing parking as an alternative to increasing supply. For instance, electronic signage can indicate where parking spaces are available. Moreover, the policy calls for reforming the price of street parking to better reflect variations in demand by block and by hour of day. This would allow the city to better manage demand and encourage rotation of vehicles in shopping areas (Montreal, 2016).

A few Canadian cities have taken further steps, actually eliminating minimum parking requirements for developments in specified areas. For instance, Halifax in Nova Scotia, St. Catharines and Oakville in Ontario, and High River in Alberta removed all parking minimums in their downtowns. Calgary, Alberta removed parking minimums for non-residential developments in the Beltline neighbourhood, adjacent to downtown (Jaffe, 2015).

In an interesting step, Canada has introduced a programme similar to the US Smart Cities competition. Cities across Canada would be invited to develop Smart Cities Plans together with local government, citizens, businesses and civil society. Participants will create ambitious plans to improve the quality of life for urban residents through better city planning and implementation of clean, digitally connected technology, including greener buildings, smart roads and energy systems, and advanced digital connectivity for homes and businesses.[14]

Appropriate public transport investment is an important part of good planning and smart cities. The central government, along with provinces and territories, plans to increase their activity in this area. Public transport per se may not have much impact on GHG emissions if, for example, subsidies allow it to run with too-low occupancy. Public transport may be attractive for some uses, but without competing with private cars in key cases. Canada's tax treatment of company cars (see Chapter 3) is an example of good practice. Many – indeed, most – countries undermine provision of public transport by subsidising commuting in company cars at the same time.

Car sharing and pooling can also reduce GHG emissions and congestion, and in low density areas may be more cost effective than public transport. Regulations can inadvertently inhibit such arrangements. In 2009, for example, Ontario had to amend its public transport regulations after a bus company successfully sued a car-sharing application company.

5.3. *Rail, air and maritime transport*

In non-road transport – rail, water and air – Canada has eschewed a strong regulatory approach in favour of working for self-regulation by the industries themselves. Often this takes place in co-operation with the United States, which is the origin or destination of many journeys, especially rail freight. Compared with private road transport, the key actors in these sectors are profit-oriented, commercial, sometime state-owned, companies rather than private individuals. In the larger transport industries (e.g. the airline industry and the two largest rail carriers), Transport Canada estimates that the share of fuel in total variable costs was between 21-26% between 2010 and 2013, similar to the share of labour costs. Saving 10% on fuel costs may increase profits by a similar percentage.[15] Such high visibility of the impact of fuel price on income gives a strong incentive to improve fuel efficiency, independent of government action.

Because road transport has been the main driver of both the level and growth of transport emissions, this section has concentrated more on road than other modes. For climate change policy to be as efficient as possible, different modes must have equivalent incentives to mitigate their GHG emissions (and other externalities). This is a difficult task. For example, there is a huge difference between emissions per tonne-kilometre of freight by road compared with rail. This suggests that policies to switch freight from road to rail could generate big savings. However, the detailed economics of rail freight compared with road are lost in the aggregate averages; to make that a definite objective might be excessively costly.

As emphasised above, and in the Pan-Canadian framework itself, carbon pricing can be a key co-ordinating element where market-based competition can operate. This implies ensuring that all transport sectors face the same tax on implied GHG fuel emissions. However, for competition to work properly, other costs should also be properly reflected in prices. As mentioned earlier, road transport escapes all direct charging for road infrastructure, while rail transport pays for it, which looks like a subsidy to road. However, rail operators pay lower provincial/territorial fuel taxes than road, which looks like an implicit subsidy as well. Unless and until road charging becomes feasible, such differential treatment could actually balance out. Calculating taxation levels under the assumption that both modes paid the same tax on GHG and other externalities would add transparency. Taxation levels should broadly offset the different treatment of infrastructure and give similar incentives to reduce GHG emissions.

Where market mechanisms cannot easily operate, carbon pricing can help. For example, it could be part of the mechanism for evaluating potential infrastructure investments that compete for financial support from the recently established Low Carbon Economy Fund.

Rail transport

Since 1995, the Railway Association of Canada and Transport Canada have been working together to reduce the emission of GHGs and local air pollutants from locomotives through a series of voluntary agreements. The most recent agreement, signed in 2013, sets targets to reduce the intensity of GHG emissions compared to a 2010 baseline. It encourages member railways to conform to the US Environmental Protection Agency's locomotive

emission standards until Canadian regulations to control criteria air contaminants emissions are introduced.[16] Under the joint Canada-US Regulatory Cooperation Council, Transport Canada and the US Environmental Protection Agency have agreed to co-ordinate their regulatory agendas, to jointly develop new requirements, and share research and compliance data and information to enhance understanding of new technologies to reduce GHG emissions in the rail industry.

Since 1990, energy efficiency in rail has improved substantially. In freight operations, fuel consumption per revenue tonne-kilometre fell by 47% between 1990 and 2014 – more than private road transport. Over the same period, the real price of rail fuel rose by around 50%. Recent data show this continuing: GHG intensity fell 12% between 2010 and 2014, ahead of the voluntary target for 2015. This is happening at the same time as rail switches to ultra-low sulphur diesel fuel. This move drastically reduces its SO_x emissions; the sulphur content of rail fuel fell about 98% between 2006 and 2014 (RAC, 2017).

Marine transport

The marine transport sector industry contributes about 2% of total transport emissions (Figure 4.12). Tax treatment varies as marine fuel is subject to the federal diesel excise tax, but exempted by most provinces from their excise product-specific taxes on fuels. It is, however, subject to British Columbia's carbon tax. In 2012, Transport Canada and the industry environmental certification programme Green Marine signed a Memorandum of Co-operation, which is the main voluntary agreement in the maritime transport sector.

Green Marine runs an audited self-evaluation programme in which ship operators, port authorities and port installation operators agree to rank their performance on a number of environmental dimensions such as GHG emissions. Other dimensions include, for example, emissions of other air pollutants, treatment of dirty oil, garbage management and energy efficiency. Companies evaluate themselves according to guidelines issued by the association. The self-evaluation has to be audited within two years by an expert chosen and paid by the company under evaluation, but approved by Green Marine. Audited evaluations are published annually, and compared with the achievements of other participants in similar categories, which is an incentive to achieve good performance.

Air transport

The airline industry's voluntary agreement between the federal government and aviation stakeholders dates to the publication of Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation in 2012. This initiative responded to the request of the International Civil Aviation Organization for Member States to submit action plans detailing specific measures to address GHG emissions. The action plan includes an aspirational target to reduce GHG emissions per revenue tonne kilometre by 2% annually from 2005 to 2020. It also targets a reduction of 1.5% per year from 2008 to 2020. The average annual reduction from 2005 to 2015 was below the target (about 1.2% per year). It has been about 1.4% per year since 2008 (GoC, 2016d).

In addition to the obvious commercial incentive for individual operators to reduce fuels costs, the measures being pursued include more efficient air operations, including air traffic management. In the future, the parties expect improvements from measures including aviation environmental research and development, alternative fuels, airport ground operations and infrastructure use.

Recommendations on climate change mitigation

Recommendations on general climate change policy

- Develop an institutional mechanism for monitoring and evaluating the implementation of climate change policy under the PCF and their contribution to meeting GHG emission targets; consider introducing mechanisms for adjusting policies over time in order to meet policy goals. One possibility is to give responsibility to the Office of the Auditor General of Canada, in collaboration with provincial audit offices.
- Implement carbon pricing in all jurisdictions; ensure that exemptions or other measures to smooth the transition for businesses are temporary and limited to emissions-intensive trade-exposed industries with limited effective abatement options; work towards increasing the share of emissions covered by a carbon price and plan for progressive tightening; identify and address interactions of carbon pricing and complementary regulations, both at the federal and provincial/territorial level.
- Promote co-ordination of sub-national climate policies and schemes and encourage linking between sub-national pricing systems, even if only at the sector level; consider the introduction of an inter-jurisdiction offset scheme to help meet nation-wide targets more efficiently. Such work could provide a foundation for a possible future transition to a full national cap-and-trade or carbon taxation system.
- Ensure that energy policy is aligned with climate change policy and other environmental goals, including with respect to future energy supplies (especially the role of renewables), grid interconnections across Canada, and demand management through pricing and energy efficiency standards; swiftly implement available energy efficiency measures and phase out fossil fuel subsidies; tighten the target and implement regulation to reduce methane emissions from energy production without further postponement, possibly aligning regulation to the tightest of regulations already in place in some US states, and improve monitoring and enforcement.
- Encourage use of the implied GHG price time path as a shadow price in policy and project evaluations, throughout government and public agencies.
- Design public education and information campaigns to enhance transparency and gain acceptance of policies and promote public support; monitor the impact of climate policy on vulnerable groups of society, ensuring that general policies for income support and welfare are well adapted to the possible impacts of climate change policies on income and employment, and that they cover all sections of the population including Indigenous peoples.

Recommendations on electricity generation

- Prioritise the elimination of fossil fuels while tapping into Canada's vast renewable energy potential; review and adjust specific support schemes for renewable energy to the trends in technology cost and carbon pricing. Where incentives beyond carbon pricing are needed, use market-based mechanisms such as reverse auctions for capacity to look for low-cost solutions.
- Ensure electricity pricing reflects full economic and environmental costs; complement pricing with information programmes like Energy Star, experimenting with other "nudging" measures to help consumers make effective use of information.
- Encourage the sharing of best practice of leading carbon capture projects across Canada based on assessments of cost and performance, including the facility at Boundary Dam in the power segment; follow through on inter-jurisdictional consultation to expand grid inter-connections to make better use of the potential for hydro storage to complement the increased variability of growing generating capacity for renewable energy.

Recommendations on climate change mitigation *(cont.)*

Recommendations on transport

- Continue to drive the decarbonisation of transport by ensuring that environmental externalities from fossil fuel use are adequately priced, either through carbon pricing schemes or direct fuel taxation; encourage the increased use of renewable fuels, electrification of transport, use of natural gas, and mode switching, including by additional vehicle and fuel taxation measures, as well as regulation.
- Continue to promote the provision of information on vehicle fuel economy and GHG emissions, including by making the EnerGuide labelling system obligatory; ensure the labelling is based on independently verified information, and laboratory testing benchmarks are monitored to ensure they are representative of performance under real-life driving conditions.
- Promote road charging, congestion charging, parking policy and other measures that both reduce the use of private transport and associated GHG emissions, and other environmental externalities; build on the Smart Cities programme to highlight and disseminate good or innovative practices; design land use and spatial planning policies to enable future low-carbon cities.
- Continue to enable the deployment of charging and refuelling infrastructure for low- or zero-emission vehicles, including by sharing information and lessons learned from pioneering municipalities, provinces and federal programmes to accelerate learning; and encourage standardisation and technology-neutral facilities to the extent possible.
- Benchmark and reduce energy use in the freight sector; encourage modal shifts in the freight sector, such as increasing the use of rail or water transport in place of long-distance heavy trucks; and encourage the development of associated infrastructure, but with appropriate cost-benefit analysis as a condition attached to public financing.

Notes

1. If the price were, say, CAD 80 per tonne of CO_2, such purchases would cost around 0.2% of Canada's 2015 GDP.
2. Mining, Smelting and Refining (Non Ferrous Metals), Pulp and Paper, Iron and Steel, Cement, Lime & Gypsum, Chemicals & Fertilisers.
3. The Specified Gas Emitters Regulation required facility-specific reductions in emissions intensity by 12% in 2015, compared with a 2003-05 baseline, declining by 8% over the following two years (except for industrial process emissions in non-energy sectors). This regulation includes a system of offsets whereby verified emission reductions elsewhere can count towards compliance, as well as crediting for capture and storage. The price for excess emissions was initially set at CAD 15. In 2015, it was announced it would rise to CAD 20 in 2016 and CAD 30 in 2017.
4. Most inventory data come from assumptions on emission rates based on benchmarks for different technologies employed.
5. Descriptive material in this section relies to a considerable extent on IEA (2016), with supplementary material from the Canadian authorities.
6. Taking the Ontario example again, the 2017 subsidy per kWh varies from CAD 0.125 (onshore wind) to CAD 0.311 (small rooftop photovoltaic). In 2012, the subsidy ranged from CAD 0.103 (landfill gas) to CAD 0.311 (small rooftop photovoltaic). This compares with an average recommended retail price of CAD 0.08 in 2012 and CAD 0.95 in May 2017 (Ontario Energy Board, 2017).
7. Quebec authorities estimated that its hydro generation capacity could be doubled – i.e. more than enough to replace all of Canada's current coal and gas-generated electricity – without excessive loss of natural habitats.

8. It should be noted, however, that the evaluation report is almost entirely based on interviews with clients or suppliers of the programmes, along with evidence from secondary literature. It is not supplemented with any statistical analysis to assess the impact of the programmes against a counterfactual. This is very difficult to do, but it can perhaps be made easier if measures – at least some of them – are designed with such an evaluation in mind. Neither does the evaluation assess the relative cost-effectiveness of the different sub-programmes (see also Box 4.1). This is also a difficult task, but would be valuable and important information.
9. For a summary of the economic literature on the extent to which US consumers make "mistakes" in ignoring price information, see Allcott (2016). He notes, for example, that regulations on phasing out incandescent light bulbs address a real ignorance of the economic benefits of switching. On the other hand, consumer responsiveness to fuel economy in cars is very high. Allcott (2013) shows that, on average, consumers correctly estimate or perhaps slightly underestimate the financial benefits of higher fuel economy vehicles. This suggests that CAFE type standards become less important if externalities are adequately included in diesel and gasoline prices.
10. Including transport services internal to other industries. Excluding such services, the share is 23%. Most freight transport data in this chapter cover only freight transported by commercial carriers, thus excluding own-use of transport in some industries.
11. Data limitations prevent a consistent accounting of emissions from transport that would derive overall emissions from volumes of different kinds of transport, the energy efficiency of each kind of transport and the emissions from each kind of energy. For Canada, some data are not measured directly, but rather by proxies for some of these underlying variables. For example, fuel use by passenger cars is calculated from assumptions about typical distance travelled and fuel economy derived from US surveys. Comparisons between Canada and other countries in this section are therefore subject to possible errors due to using indicators from data sources that might not be fully consistent.
12. Specifying the regulation in terms of GHG emissions eliminates any need for separate standards according to fuel type.
13. Medium and large heavy-duty vehicles have their target values determined based on vehicle characteristics such as weight, roof height and primary function (tractors or vocational vehicles). Performance for these medium and large heavy-duty vehicles is assessed through the use of a simulation model based on vehicle characteristics. Medium and large heavy-duty engines have output-based performance standards that are assessed through engine dynamometer testing.
14. In the United States, the city of Columbus, Ohio, won the competition with a "comprehensive, integrated plan addressing challenges in residential, commercial, freight, and downtown districts using a number of new technologies, including connected infrastructure, electric vehicle charging infrastructure, an integrated data platform, autonomous vehicles, and more. Columbus plans to work closely with residents, community and business leaders, and technical experts to implement their plan." See *www.transportation.gov/smartcity/winner*.
15. For instance, when the average price of diesel for rail use fell 30% in 2015, the railway company Canadian Pacific saw a drop in fuel costs equivalent to one-quarter of its net income for 2014 (Transport Canada, 2016b; Canadian Pacific, 2017). Air Canada's fuel costs in 2015 and 2016 were similar to the wage bill, in each case around one-fifth of total operating expenses (Air Canada, 2017).
16. These include SO_x, NO_x, volatile organic compounds, carbon monoxide, ammonia, ground level ozone and particulate matter.

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PART II

Chapter 5

Urban wastewater management

This chapter examines urban wastewater management policies in Canada over the last decade. It discusses recent developments that have strengthened the policy framework. These include the Canada-wide Strategy for the Management of Municipal Wastewater Effluent and the first national regulation for wastewater treatment. The chapter highlights some of the most salient challenges that still need to be tackled, including the detrimental situation of Indigenous peoples, the lack of a sustainable financing strategy and the need to swiftly adapt to a changing climate and precipitation patterns. It suggests areas for improvement in the use of pricing instruments and of incentives to explore innovative approaches to manage waste- and rainwater, among others.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Introduction

Freshwater plays a crucial role in Canada's society and economy, and wastewater management is an essential driver of water's availability and quality. Water is abundant nationally and generally of good quality, even though some areas of concern remain in urban environments or agricultural areas. Wastewater discharges represent one of the largest emissions by volume into the Canadian environment. Significant investment is required to provide access to appropriate levels of treatment across provinces and territories, to renew existing infrastructures and to adapt to a changing climate. Indigenous communities remain in a disadvantageous position. Energy production, urbanisation and, to a lesser extent, agriculture have increased tensions on water quantity and quality. Climate change is adding more uncertainty about future water availability and needs.

In that context, policy responses to urban wastewater challenges have changed markedly. This is most clearly illustrated by the 2009 Canada-wide Strategy for the Management of Municipal Wastewater Effluent and the 2012 Wastewater Systems Effluent Regulation. More recently, the 2015 mandate letter to the Minister of the Environment and Climate Change included an explicit reference to "investments in the best wastewater treatment technologies" in pursuit of freshwater protection and stewardship. This testifies that urban wastewater collection and treatment ranks high on the federal policy agenda.

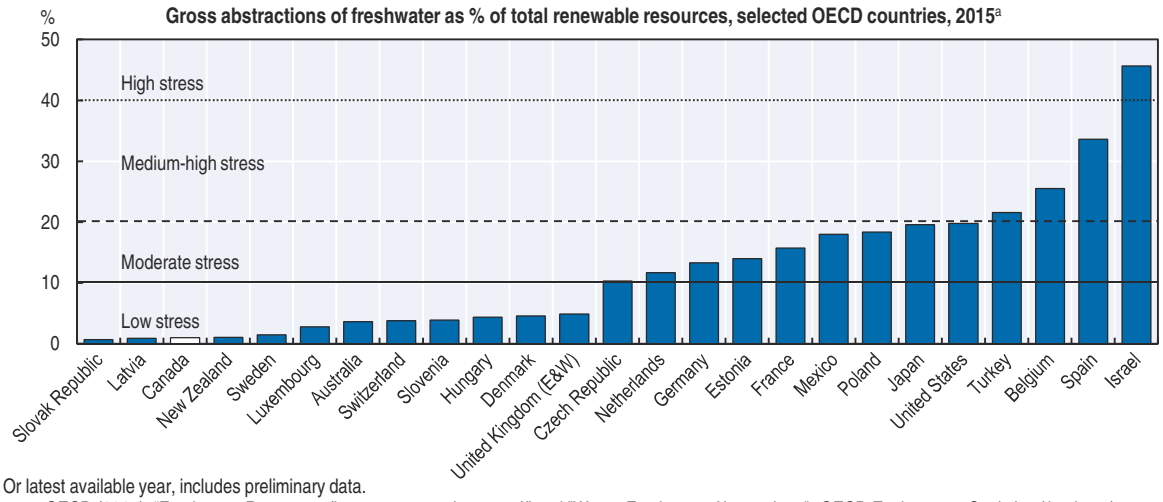
2. Status and trends in urban wastewater management

2.1. Urban wastewater in the context of water management in Canada

Canada has about 7% of the world's renewable water. Water stress, defined as the ratio of water abstraction on renewable resources, is among the lowest in OECD member countries (Figure 5.1). Aggregate figures, however, mask significant regional disparities: much of Canada's renewable water supply is out of reach for the general population. Renewable water available in the most populated areas of the country dropped by 8.5% between 1971 and 2004 (Statistics Canada, 2010). Episodes of drought are experienced across Canada, particularly affecting the interior of British Columbia, the Prairies, as well as southern Ontario and southern Quebec. The Great Lakes area is affected by variable water levels, which impair capacity to absorb and dilute nutrients. Further, Canada is among the OECD member countries with the highest freshwater abstraction per capita (Figure 5.2). This is putting pressure on freshwater supply in some urban areas.

Overall, freshwater quality of Canadian rivers and lakes is fair to good and remained relatively stable between 2003-05 and 2010-12. At the regional level, water quality is a concern, however, particularly near city centres and in agricultural areas (Wood, 2013). Key pollution sources include excess nutrients (phosphorous and nitrogen) from agricultural and wastewater sources, persistent toxic substances (from industrial or domestic uses), and emerging chemicals of concern from urban and industrial sources. The application of nitrogen fertilisers increased twice as fast as agricultural production since 2000 (Chapter 1). With improved control of source pollution, the control of diffuse pollution, such as urban

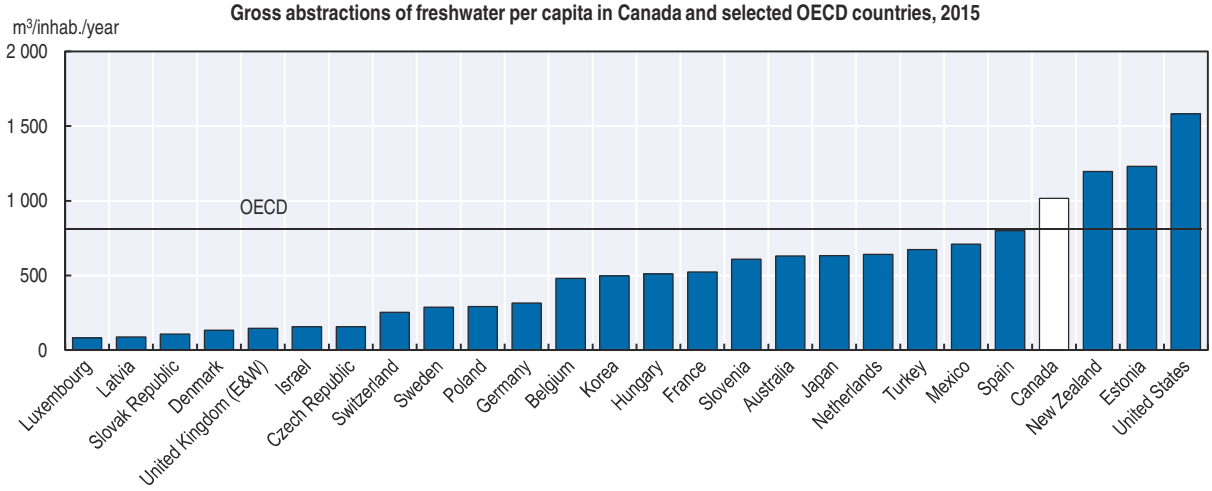
Figure 5.1. **Canada experiences no water stress at national level**



a) Or latest available year, includes preliminary data.
Source: OECD (2017), "Freshwater Resources (long term annual average)" and "Water: Freshwater Abstractions", *OECD Environment Statistics (*database).

StatLink http://dx.doi.org/10.1787/888933565963

Figure 5.2. **Canadians are profligate water users**



Note: Includes provisional data. Data referring to years before 2010 have not been included.
Source: OECD (2017), "Water: Freshwater Abstractions", *OECD Environment Statistics* (database).

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or agricultural run-off, is likely to be a more efficient and effective way to improve water quality in Canada (see OECD, 2017a).

Effluent from wastewater systems represents one of the largest sources of pollution in Canadian waters, by volume. Municipalities released 6.4 billion cubic metres (m^3) of wastewater in 2006. Manufacturing and mineral extraction released another 4.2 billion m^3 and thermal-electric power generation industries another 25.2 billion m^3 of wastewater in 2013 (Statistics Canada, 2017). Most of this undergoes some type of treatment before it is released. However, an estimated 205 million m^3 of untreated wastewater was released into Canadian rivers and oceans in 2015 (CBC, 2016).

The impact of urban wastewater effluent on water quality varies across the country, reflecting the large variation in treatment levels (Section 2.2 and Table 5.1). Monitoring

Table 5.1. **Overview of water quality that relates to wastewater**

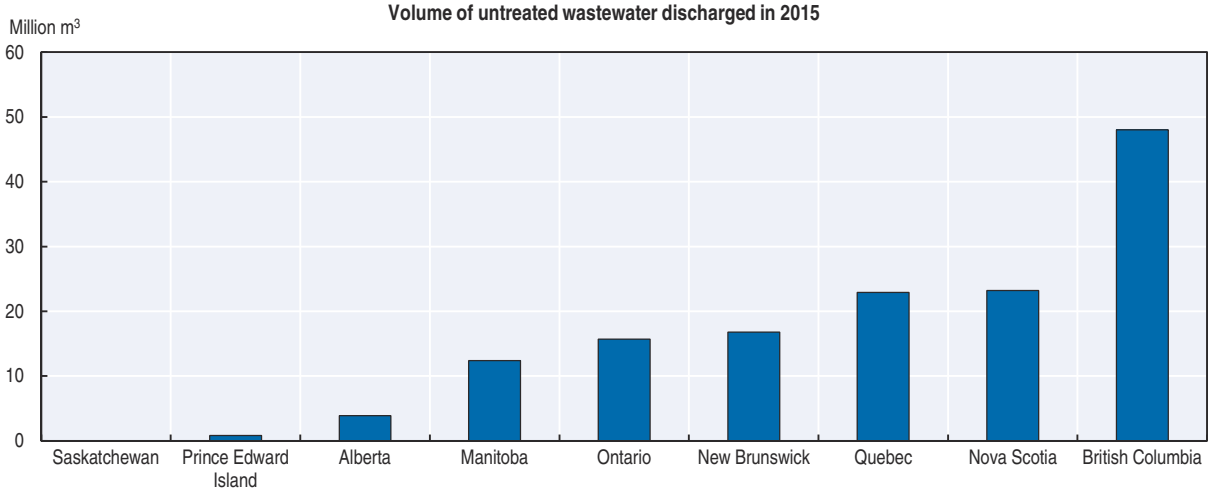
British Columbia	A resource-based economy (including mining, pulp and paper) has put pressure on water resources. Levels of many pollutants have decreased over the past few decades due to government regulatory actions. Tertiary treatment of wastewater has reduced phosphorus loads in rivers and lakes (Lake Osoyoos, Columbia River). Metro Vancouver deserves further attention, as it suffers from an ageing infrastructure not up to current and future challenges (in particular). Levels of faecal coliforms still increase at places (although below guidelines for recreational use). The construction and expansion of combined sewers is not permitted under existing provincial regulation and existing combined sewers must be separated upon repair or renewal.
Alberta	The level of water quality is very good and was stable between 1996 and 2009, although Alberta is the fastest growing province in terms of population and the home of Canada's oil extraction industry, which uses water and produces large amounts of wastewater. Improvements to wastewater treatment plants have reduced nutrients and bacteria in rivers and lakes. Alberta claims that provincial wastewater effluent standards are more stringent than the national ones established in 2012; this is debatable in selected areas; for instance, Alberta has no effluent quality standards for lagoons without aeration. The construction of combined sewers overflows has not been allowed since the mid-1980s.
Saskatchewan	91 municipal wastewater treatment plants discharge treated effluent to natural waterways. Approximately 98% of these systems use lagoons as the treatment method, with another 2% having systems that use mechanical treatment plants. Trends of water quality are not well documented or publicised, except for nutrients. Nutrient flow (naturally high in the province) shows contrasted trends across rivers. Combined sewers are prohibited in the province.
Manitoba	Manitoba had established effluent standards prior to the 2009 Canada-wide Strategy for the Management of Municipal Wastewater Effluent that are considered to be as or more stringent than the national performance standards. The population is almost entirely served by secondary-mechanical treatment. Mediocre water quality in Lake Winnipeg and Lake Manitoba. The construction of combined sewer has not been permitted for decades.
Ontario	Some persistent, bio accumulative and toxic substances (PBTs) have declined substantially since the 1980s, but some remain at concentrations that still pose a threat to human health and the environment. Phosphorus concentrations have decreased in many rivers and lakes since the 1970s, as illustrated by Lake Simcoe. They have also decreased in the offshore waters of most of the Canadian Great Lakes. Conversely, there are excess nutrients in many nearshore areas. While a certain level of nutrients is good, too much may lead to the development of nuisance and harmful algal blooms. Pharmaceuticals in drinking water are not at levels that create concerns for human health. Ontario does not allow the construction of new combined sewers. For existing combined sewer systems, Ontario policy requires capture and treatment of wet weather flow, and prohibits dry weather overflows. The city of Ottawa is building a combined sewer storage tunnel to reduce the frequency of sewage overflows during storms from entering the Ottawa River. The CSST project is a CAD 232.3 million investment. The government of Canada and province of Ontario are each providing CAD 62.1 million. In addition, the city has committed CAD 108 million.[3]
Quebec	The St. Lawrence River is affected by municipal wastewater from urban communities. The situation is improving, due to improvements in municipal wastewater treatment. Bacterial contamination increased in 2004/05 as wastewater treatment plants in Montreal, Longueuil and Repentigny do not disinfect effluents. The failure to adequately maintain urban water infrastructure results in increased operational costs for water and wastewater systems due to non-revenue water or the infiltration of storm water into sewers (Baltutis and Shah, 2012).
New Brunswick	The province has generally very good quality surface water, although bacteria levels in the Saint John River remain high and above the guidelines for recreational use. New Brunswick requires overflow management plans for upgraded pumping stations associated with new development. All municipalities were required to develop long-term plans to reduce combined sewer overflows and reduce overflows from infiltration by 1 January 2016.
Nova Scotia	Phosphorus is increasing in several rivers. Nitrate exceeds guidelines for protection of aquatic life in the Mersey River. Monitoring capacity has improved with the development of an automated network of monitoring devices. The province is affected by ageing and inadequately maintained storm water and wastewater infrastructure (Baltutis and Shah, 2012)
Prince Edward Island	Nitrogen levels are high and rising in this small, agriculture-centred province. Regulation allows for the construction of combined sewers, even though the province has not approved any new ones for many years. A programme to eliminate combined sewer overflows in the sole remaining community with combined sanitary-storm sewers is nearing completion.
Newfoundland and Labrador	Water quality is rated fair or above. Nutrient levels are decreasing, except near St John's.
Yukon	Yukon does not have combined sewer systems.
Northwest Territories	Extreme climate conditions make standard wastewater collection and treatment systems inappropriate. Difficult road transportation hinder operation and maintenance. No Northwest Territories communities have combined sewer and storm water systems.

systems also vary, reflecting the size and diversity of the country, and the specificities of local situations. The fragmented (and at places incomplete) monitoring systems impair a comprehensive assessment of the performance of wastewater treatment systems. No source of information compiles data on the performance of wastewater systems nationally.

Discharged wastewater needs to be managed in conjunction with urban run-off, which is caused by heavy rains. Where waste- and rainwater are conveyed in the same sewer,

heavy rains can lead to sewer overflow and release of untreated wastewater into the environment. Environment and Climate Change Canada (ECCC) inventories 268 systems (out of more than 3 000) that generate overflows in Canada, and 2 933 points of overflow (one system can generate overflows in several points). In 2015, these systems released 144 million m^3 of untreated wastewater (Figure 5.3); Quebec alone hosts 178 such systems. Combined sewers are largely a legacy of early settlements. Their construction is banned in all Canadian provinces, but retrofitting existing systems is costly and takes time. In Quebec, for example, the cost of minimising combined sewer overflows is estimated at CAD 6.2 billion (Gouvernement du Québec, 2013). Changing precipitation patterns, coupled with the extension of sealed surfaces, increase run-offs in urban areas, putting existing infrastructures that collect and treat rain water to their limit.

Figure 5.3. **Combined sewers released 144 million m^3 of untreated sewerage in 2015**



Source: Environment Canada, personal communication based on summary of the information submitted by owners and operators of wastewater systems for the year 2015.

StatLink http://dx.doi.org/10.1787/888933566001

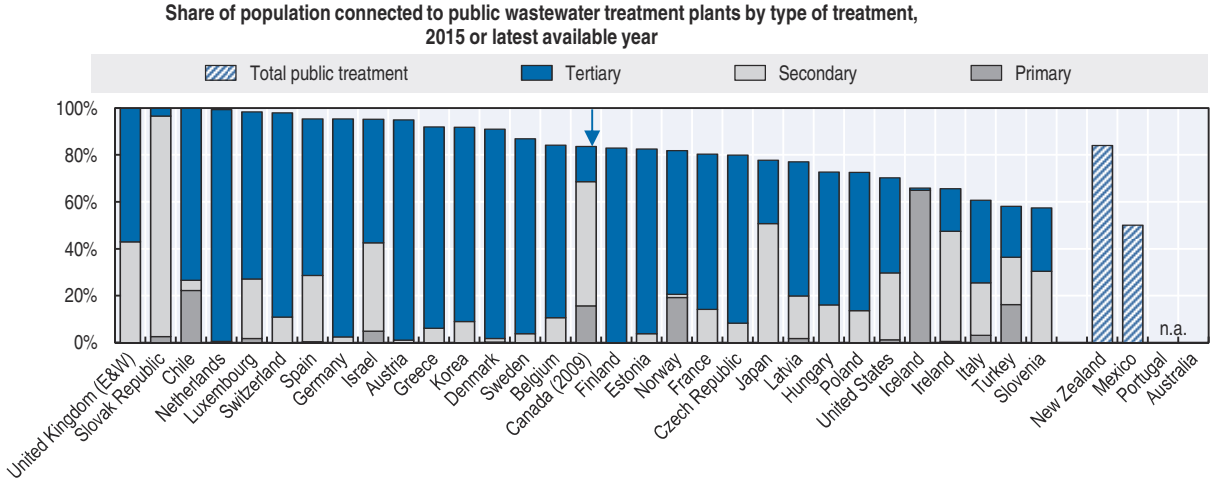
Organic micro-pollutants, such as pharmaceuticals and pesticides, can have detrimental effects on water quality even in trace concentrations. However, wastewater containing such pollutants is particularly difficult to treat. In May 2016, the government of Canada (in a joint action with the United States) identified eight new Chemicals of Mutual Concern, under the Great Lakes Water Quality Agreement. All designated Chemicals of Mutual Concern are listed under the List of Toxic Substances under the Canadian Environmental Protection Act, and, as such, are subject to federal risk management. Environment and Climate Change Canada (ECCC) is working with the US Environmental Protection Agency to develop binational strategies to address these eight chemicals, which may include additional research, monitoring, surveillance and pollution prevention and control measures. Quebec sees such substances as a potential threat, but not an immediate risk, as their presence is still below the provincial threshold. The province organises surveillance on drinking water at wastewater treatment plants.

2.2. Access to wastewater collection and treatment

More than 3 000 wastewater systems operate in Canada. The 2009 Municipal Water and Wastewater Survey indicates that 87% of the population is served by sewers; the remaining

population uses private septic systems (12%) or sewage haulage (less than 0.5%). Of the population served by sewers, 3% receives no or only preliminary treatment (ECCC, 2011a).[1] More than half of the population was served with secondary treatment, which removes most conventional pollutants.[2] Another 15% of the population are served with tertiary treatment, which aims to remove such harmful elements as suspended solids, phosphorus or specific compounds (e.g. pesticides or metals). This is a relatively low share compared to most other OECD member countries (Figure 5.4). All told, 15% of Canadians receive primary treatment, which is rather large in international comparison.

Figure 5.4. **A comparatively large share of Canadian population still relies on primary wastewater treatment**



Note: Includes preliminary data. Data earlier than 2010 have not been considered except for Canada.
Source: OECD (2017), "Water: Wastewater Treatment (% Population Connected)", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933566020

Access to, and level of, wastewater treatment varied widely between provinces (ECCC, 2011a). Primary treatment was prominent in Newfoundland and Labrador, Nova Scotia, Quebec and, to a lesser extent, British Columbia; in Quebec, 81 municipalities released untreated wastewater and 14 wastewater treatment plants only provided primary treatment; Montreal, which accounts for half of wastewater released in the province, provided primary treatment only. Similarly, much of Vancouver's population is served by primary treatment only. The populations of Ontario and Manitoba are almost entirely served by secondary-mechanical treatment, while 78% of Alberta's population is served by tertiary-level wastewater treatment. The contrasted situation across the country requires policy instruments and governance structures that are targeted to local circumstances. Federal regulations and standards need to provide provinces and municipalities with flexibility on how to improve performance.

Most Indigenous and northern communities rely on secondary-level wastewater treatment systems, such as lagoons that discharge treated effluent into designated natural receivers. All treatment systems are subject to applicable provincial and federal requirements. Continued research is needed to better understand the treatment efficacy of natural systems and the impact on ecosystem health. Better knowledge will also help determine potential design parameters for northern wetlands. These are a key component in developing northern performance standards that the governments of Northwest Territories,

Nunavut, Quebec, and Newfoundland and Labrador have committed to develop in the context of the Canada-wide Strategy for the Management of Municipal Wastewater Effluent.

2.3. Wastewater treatment and Indigenous communities

Access to wastewater treatment in Indigenous and northern communities is unsatisfactory. Access to safe water and wastewater services is generally lower than other populations. According to an assessment conducted between 2009 and 2011 of 532 community wastewater systems, 14% posed high overall risk to the community members they serve, 51% posed medium overall risk and 35% low overall risk (INAC, 2011). It concluded that substantial investment in infrastructure for wastewater systems in First Nations communities was required, along with investments in capacity building for operation and maintenance, and operator qualification. The situation of Métis people is more favourable, as a large majority of Métis people lives in urban areas. Some observers contend that the lasting unequal access of Indigenous peoples to safe water, wastewater services and water security in general results from 140-year-old biased social-political dynamics, which fail to acknowledge Indigenous knowledge of land, resources and water management (Castleden et al., 2017).

Between 2006 and 2015, the government of Canada invested around CAD 3.1 billion in water and wastewater infrastructure and related public health activities in First Nations communities (INAC, 2016). Federal funding is mostly allocated under the 2008 First Nations Water and Wastewater Action Plan (FNWWAP), which is co-ordinated by Indigenous and Northern Affairs Canada (INAC), in with support from Health Canada. Indigenous communities also invest in water and wastewater systems and activities through their own revenues and various other government sources at the local, provincial and federal level. Indigenous communities commit to cover 20% of the operation and maintenance costs of on-reserve water supply and sanitation systems. As a result of investments, the 2015/16 annual inspection of federally funded water and wastewater treatment systems shows marked reduction of exposure to risk, compared to the 2009-11 situation (Table 5.2).

Table 5.2. **Risk exposure from wastewater systems in First Nations communities**
Percentage of community wastewater systems posing an overall risk to the community members they serve

Level of risk	2009-11 %	2015/16 %
High overall risk	14	3
Medium overall risk	51	52
Low overall risk	35	45

Source: INAC (2016); INAC (2011).

The third Federal Sustainable Development Strategy (FSDS) 2016-19 sets targets that relate to wastewater collection and treatment in Indigenous communities. It aims to increase the share of on-reserve First Nations drinking water systems with low risk ratings from 27% in 2011 to 65% by 2019. It also seeks to increase the percentage of on-reserve First Nations wastewater systems with low risk ratings from 35% in 2011 to 65% by 2019. While the realisation of these objectives would constitute a marked improvement in the situation of Indigenous peoples, the objectives look minimal compared to standard performance in Canada. The FSDS 2016-19 aims to resolve 60% of long-term drinking water advisories affecting First Nations supported by INAC by March 2019; 100% should be resolved by March 2021.

The focus on financial support to infrastructure development continues, accompanied by skills development and the establishment of technical hubs to support operation and maintenance of existing systems. Starting in 2016/17 and over a five-year period, Budget 2016 is investing CAD 1.8 billion for on-reserve water and wastewater infrastructure through INAC's programmes (INAC, 2017). The effectiveness and efficiency of such federal spending will depend on the capacity of INAC and Infrastructure Canada to select and support projects that improve the situation on the ground. The selection procedure to access funds managed by Infrastructure Canada urges municipalities to prioritise wastewater in their investment portfolio; it does not necessarily ensure the best value for public moneys (see also Section 5). Effective public spending will also depend on minimising the impacts on water resources of developments on Indigenous land. New developments or transport infrastructures that affect the quality of groundwater on which Indigenous communities depend can result in water scarcity or more expensive treatment.

The 2013 Safe Drinking Water for First Nations Act enabled the federal government, in partnership with First Nations, to develop enforceable federal regulations to ensure access to safe, clean and reliable drinking water, the effective treatment of wastewater and the protection of sources of drinking water on First Nations lands. INAC, in consultation with Health Canada, has established non-binding water and wastewater protocols that aim to help ensure that residents on First Nations lands enjoy standards of health and safety comparable to other Canadians. However, no enforceable standards have been developed to date. Many First Nations do not support the act and INAC is currently reviewing its approach. Wastewater systems on First Nations lands that meet the threshold of the WSER are required to meet its effluent quality standards.

A challenge remains to fully engage with Indigenous peoples. Although First Nations, Métis and Inuit communities differ, in particular as regards the nature and legal definition of rights to land and water, they are best characterised as *right holders*, and not mere *stakeholders* (see also Chapter 2). These rights can compete with federal, provincial or private ambitions to develop energy (i.e. hydropower) or to transport fossil fuel across Indigenous territories. The Site-C dam illustrates a situation where a valley was flooded in contradiction with existing treaties (see Box 2.7 in Chapter 2).

Canada's adherence to the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) in May 2016 is an important step forward. It will materialise when pending issues are addressed, in particular the practical definition of "consultation" and an agreement on the definition of free, prior and informed consent. The question of whether the right to oppose a project constitutes a veto remains subject to debate. While Indigenous communities are more routinely consulted, these consultations essentially focus on the impacts of specific projects, with a view to reach a compensation agreement. However, O'Faircheallaigh (2010) notes that such agreements also raise major issues for Indigenous peoples' relations with other actors and institutions, including government, environmental groups and the judicial system. Typically, most agreements require that Indigenous peoples either support the project or refrain from opposing it in environmental assessment and regulatory proceedings (Salée, 2005). Similarly, confidentiality provisions can limit communication options.

A step change would base consultations on rights, with a view to mitigate the environmental impacts of projects and regulations on Indigenous land. The Species at Risk Act, developed in the 1990s, is considered good practice. The revision of the Act on Environmental Impact Assessment provides an opportunity to replicate the former.

Innovative approaches being explored in New Zealand may be a source of inspiration, while acknowledging that legal statuses of Indigenous peoples and rights may differ (see Box 5.1). This step change also requires that Indigenous peoples streamline their organisation and clearly identify who should be consulted: discussions with leaders may not reflect a community's opinion, putting implementation at risk.

Box 5.1. **New Zealand iwi rights to water**

The Freshwater Iwi Leaders Group, established in 2007, is proceeding to resolve with the Crown how to recognise iwi proprietary rights in freshwater quantity and quality. One avenue being explored is a nationwide recognition of iwi interests in the form of an equitable, permanent share of water entitlements and discharge allowances allocated for commercial use. A permanent allocation of water to iwi would not be the first time a mechanism has been considered that simultaneously recognises the commercial value of a natural resource to iwi, and a societal need for more clarity around interests in that resource. For example, the Fisheries Quota Management System in 1992 was used to recognise iwi proprietary rights in fisheries and to revolutionise management of the fishery resource for the benefit of New Zealand.

Another option explored by the Leaders Group to provide recognition of Māori water is to introduce a resource rental (or royalty) regime under which Māori would be paid for the commercial use and pollution of their waters. There are already some forms of resource rentals in New Zealand, particularly in relation to the extraction of coal, precious metals, oil and gas, geothermal energy, sand and gravel, and more recently coastal space. Charging resource rent on the commercial use of freshwater resources and paying those rentals to Māori who have proprietary interests would be one way for the Crown to meet its Treaty obligations.

Alternative forms of recognition of Māori rights in freshwater bodies could be considered, such as granting legal personhood to a water body, or granting ownership of the bed and water column of a water body to a Māori trust. For example, the Te Awa Tupua [River with Ancestral and Extraordinary Power] framework for the Whanganui River affords the highest level of protection – legal personality – to Te Awa Tupua. It aligns with a Māori world view that has always regarded rivers as containing their own distinct life forces. Another example is the granting of ownership of the bed and the water column of Lake Taupō and its tributaries to Tūwharetoa Māori Trust Board.

Source: OECD (2017b), *OECD Environmental Performance Review of New Zealand*.

2.4. How a changing climate affects wastewater management

Climate change is adding distinctive pressures on wastewater management in Canada. First, more frequent thaw increases cold run-off, affecting biological nitrogen removal and the efficiency of secondary treatment. Debris can block flows and trigger local flooding.

Second, precipitation has increased by approximately 17% for the 1948-2015 period. The biggest increases have been observed in the North (e.g. annual precipitation in northern Canada has increased 33%, compared to 8% in southern Canada). Precipitation in southern Canada is increasingly falling as rain (as opposed to snow), while in northern Canada, precipitation is increasingly falling as snow (NRCan, 2008). Heavier rains, coupled with the extension of sealed surfaces, increase run-offs in urban areas. These put existing infrastructures that collect and treat rain water to their limit, increasing risk of combined sewer overflows. They also increase energy cost of pumping water through the networks.

Third, the frequency and severity of storms are increasing across the country. From 1900 to 1990, for example, Newfoundland and Labrador was hit by about six hurricanes and tropical storms per decade. Between 1990 and 2015, this ratio has more than doubled. Moreover, these storms are now extending from the July and August timeframe to as late as October. Extreme storms, which result in storm surge, and over-land and coastal flooding, affect emergency and disaster planning, public health, infrastructure planning and water management. Yukoners as well are experiencing more extreme weather events, including lightning storms and flash floods.

These impacts are projected to accelerate in the future. In the North, warming will affect the amount and distribution of rain, snow and ice, as well as the risk of extreme weather events (e.g. heat waves, heavy rainfalls and related flooding, dry spells or droughts, and forest fires). Precipitation is projected to increase in the future, with annual total precipitation increases in the range of 0-10% in southern Canada in 2080, and up to 40-50% in the North. Storm frequency is expected to increase, with subsequent increases in storm surges, coastal flooding and coastal erosion (NRCan, 2008).

Alberta Government (2009) signals some of the main impacts of climate change on municipal wastewater management:

- Increased evaporation in lakes and reservoirs leads to decreased assimilative capacity of water bodies for municipal wastewater effluent.
- Droughts will have negative effects on water quality and will decrease a river's capacity for wastewater assimilation.
- Higher intensity of precipitation events will increase the amount of storm water that needs to be treated. Storm water in urban environments can be heavily polluted, as water picks up contaminants ranging from sediment, nutrients, hydrocarbons, heavy metals, road salt, pesticides and animal waste. This polluted water is mainly discharged into a water body untreated. In the case of combined sewers, large storms can result in raw sewage and polluted storm water bypassing the wastewater treatment facility.

Adaptation to climate change has, however, been slow across the country. Most sub-national governments have either a climate change adaptation strategy or plan, or take climate change adaptation into account in their water strategies or plans. However, the 2016 Canadian Infrastructure Report Card estimates that only 16% of municipalities have formally factored climate change adaptation into decision- making practices for wastewater.

3. The institutional framework

Fragmented governance is a recurring theme in water governance in Canada (Renzetti and Dupont, 2017). Powers to control water pollution are shared between federal and provincial governments, while the delivery of water and wastewater services is shared between provinces and municipalities. Several platforms exist to co-ordinate initiatives, share knowledge and raise awareness. Notwithstanding, marked discrepancies in policy objectives and wastewater services performance can be found across the Canadian territory. More systematic use of incentives could help align initiatives across levels of government. Multi-level governance contracts have delivered in several OECD member countries and could be considered, supported by strategic uses of federal or provincial funds. Incentives could also be set up to expedite the development of federal-provincial or federal-territorial bilateral agreements for wastewater standards.

3.1. Division of powers and responsibilities

The main federal legislation governing water resources management is the 1970 Water Act, revised in 1985. The act provides that provinces manage wastewater, including issuing permits or licences for the construction and operation of wastewater treatment plants, using their own legislative and regulatory or non-regulatory frameworks. The federal government is responsible for water issues associated with federal lands, fisheries, oceans, shipping, navigation, criminal law, international relations, and boundary and transboundary waters. The federal government also regulates pollution from wastewater effluent under the Fisheries Act (see below). Powers to manage water and water pollution are hence shared between the federal and provincial governments and – to a certain extent – overlap.

In Yukon and the Northwest Territories, land, water and resource management falls under the responsibility of the territorial government. In Nunavut, management responsibility lies with the federal government, while the negotiations of a devolution Agreement-in-Principle are ongoing.

River basin (or watershed) authorities are in charge of catchment protection, monitoring of river flows and water quality. They are not decision-making bodies, however.

The overall responsibility for the delivery of water and wastewater services is shared among the provincial governments and municipalities (in Canada, municipalities are features of the provinces; see Chapter 2). Municipalities are the primary owners of the vast majority of water systems in Canada. They also make front-line decisions on current and future water management challenges. Further, they bear financial responsibility for their systems, although federal and provincial government grants and programmes support a number of activities.

Indigenous communities own, manage and operate their water and wastewater systems. INAC provides funding and advice with regards to the design, construction, operation and maintenance of treatment infrastructure. In addition, it provides protocols, and funding and training for water treatment plant staff. ECCC regulates treatment of wastewater discharged to receiving water bodies. In First Nations reserves south of the 60th parallel, the management of drinking water quality and wastewater is a shared responsibility among Indigenous communities and the federal government (INAC and Health Canada). As for north of the 60th parallel, territorial governments are responsible for safe drinking water in all communities in their territories, including Indigenous communities.

3.2. A complex system of involved institutions require extensive co-ordination

The fragmented governance for water and wastewater management makes inter-governmental co-operation a necessity. At federal level, ECCC sets standards for wastewater systems effluent (see Section 4). Health Canada works with ECCC to assess the potential risks to human health posed by new and existing substances in Canada under the 1999 Canadian Environmental Protection Act (CEPA). The Ministry of Infrastructure and Communities delivers significant volumes of funding to provinces, territories and municipalities.[4] The Ministry of Fisheries, Oceans and the Canadian Coast Guard and ECCC are involved in protecting the Great Lakes, the St. Lawrence River Basin and the Lake Winnipeg Basin. INAC works with Indigenous communities to improve their essential physical infrastructure in collaboration with the Ministry of Infrastructure and Communities, and other stakeholders.

The federal government supports the work of the International Joint Commission (IJC) between Canada and the United States. It also manages and helps resolve disputes regarding boundary and transboundary waters.[5]

Platforms are in place to make governance for urban wastewater management more coherent. These include the Canadian Council of Ministers of the Environment (CCME) and the National Advisory Committee (NAC) – the two key forums for federal-territorial-provincial collaboration for environmental policy (see Chapter 2). In addition, the Federation of Canadian Municipalities (FCM) and the Canadian Water and Wastewater Association (CWWA) represent the interests of Canada's municipalities and public sector municipal water and wastewater services, respectively. River basin or watershed bodies facilitate consultation of stakeholders; they are also active in outreach, awareness raising and education. The Association of River Basin Organizations of Quebec (ROBVQ), for instance, has structured its experience in engaging with stakeholders around five levels of engagement (see OECD, 2015a).

These platforms facilitate information sharing and co-ordination. However, they do not provide concrete incentives to align initiatives across levels of governments. International experience with multi-level governance contracts can inspire further co-ordination mechanisms for urban wastewater management in Canada (see Box 5.2).

Box 5.2. **Multi-level governance contracts in Brazil, Italy and the Netherlands**

OECD (2015b) has characterised arrangements to co-ordinate policies across ministries and public agencies: inter-governmental councils or special commissions, regional agencies, contracts and conditionalities.

The national pact for water management in Brazil

In 2011, the Brazilian National Water Agency designed the Water Management Pact to enhance integration between federal and state water resources systems, to foster convergence across states' performance and to reduce regional discrepancies in water governance. The pact, which all states adhered to, clearly defined federal and state targets. States were clustered into homogeneous categories according to their degree of water management complexity to better address specific needs in terms of legal, planning, information and operational instruments, human resources and governance. In addition, the pact included a financial incentive mechanism called Progestão to accelerate implementation. The mechanism allocated BRL 100 million (approximately CAD 40 million) for water management over five years, distributing funds equally to states that reach established goals. Rewards are based on progress in achieving targets rather than on specific outputs.

While it faces some challenges, the pact promotes consistency, integration and dialogue across levels of government, with capacity building and support to decentralised water policy. Goals set in the pact contribute to reducing asymmetries of information between federal and state institutions. The pact reflects the subsidiarity principle, which preserves the autonomy of states while engaging them towards shared responsibility to reach common goals.

Framework programme agreements in Italy

The *Accordi di Programma Quadro* (APQs) are frequently used as multi-level governance instruments for regional development policies in Italy, including natural resources and infrastructure areas. They rely on strong co-operation between sub-national governments, the Ministry of Economic Development and relevant central administrations. For each region and infrastructure sector (e.g. water), an APQ is signed when the projects and the necessary funding resources are identified. Beneficiaries and needs are identified based on

Box 5.2. **Multi-level governance contracts in Brazil, Italy and the Netherlands** *(cont.)*

regions' selection of priority sectors. AQPs pool multiple sources of financing (ordinary and additional public resources, EU funding and private resources) that are allocated by the Inter-ministerial Committee for Economic Planning. APQs include a programming section and an implementation section. The former lists interventions that are in accordance with the general objectives, but for which the required technical and financial conditions are not satisfied. For each intervention, APQs indicate needed tasks, as well as actors responsible for implementation, procedures, and monitoring and evaluation of outcomes. Implementation of APQs is monitored.

A successful example is the APQ signed between Apulia, Basilicata and the Ministry of Infrastructure and Transportation (in 1999) to address water shortage in Apulia. It committed the two regions to recover 20% of the resources by 2015 through water savings, planning and control of consumption, modernisation of irrigation systems, metering, monitoring of leakages and non-conventional resources. The first APQ came to an end in 2015 and a new one came into force for 2016-30.

Administrative agreement of water affairs in the Netherlands

The Administrative Agreement on Water Affairs (2011) was signed between the Ministry of Infrastructure, the Ministry of Environment and the main stakeholders in the Netherlands. These included the national water authority, the association of (12) provinces, the association of (408) municipalities, the association of (23) jurisdictional water authorities and the association of (10) drinking water companies. The agreement promoted important developments in the allocation of roles and responsibilities, as well as cross-sectoral planning integration between central and provincial authorities (water, environment and spatial planning). Savings of EUR 750 million annually by 2020 are expected across the water chain through reducing the control and supervision functions, learning and knowledge-sharing, clear agreements about the division of tasks and reallocation of roles and responsibilities when organisations can perform the same tasks better and cheaper.

The Dutch government contracts directly with cities as well. The Climate Adaptation City Deal was signed in 2016 between the Ministry of Infrastructure and the Environment, three jurisdictional water authorities, five cities and seven partners (research centres and companies). It aims to create a learning environment for climate adaptation at urban level for the next four years, fostering co-operation and complementarities across water and spatial planning (see Charbit and Romano, forthcoming).

Source: OECD (2015b) (Brazil); OECD (2014) (Netherlands), OECD (2007) (Italy), Venanzi and Gamper (2012).

Prevailing institutional arrangements may be challenged by evolutions of the workforce in Canadian municipalities. CWWA notes that demographic shifts in retirements compared with new entries to the workforce and changing career habits may affect the expertise and skills of people in charge of wastewater management. New skills are also required to deal with the increasing complexity of regulations and policies, as municipalities need to reconcile the management of assets, plans and risks that have historically been dealt with separately.

4. The policy framework

The large variation in the regulatory and policy frameworks across provinces has prompted the federal government to develop a Canada-wide strategy for municipal

wastewater management. As part of the strategy, the government has also created a set of effluent regulations that would bring all wastewater treatment plants to secondary treatment. In line with the OECD Council Recommendation on water (OECD, 2016a), the federal government takes a risk-based approach. It mandates provinces to assess their own risk, set priorities and address high-risk areas. Work is underway to assess how provincial standards align with federal ones. Additional measures are needed to ensure that all water users contribute to policy objectives and that urban water management in all areas contributes to wider policy objectives of environmental health.

4.1. The Fisheries Act, a distinct perspective

The legislative and regulatory basis for federal wastewater effluent regulation is unique, as it derives from the Fisheries Act (1985). This act prohibits the deposit of deleterious substances into waters frequented by fish, unless authorised by regulations under the Fisheries Act or other federal legislation. Wastewater regulations are therefore based on a responsibility to not harm fisheries, rather than protecting human health or ecosystem health. This approach may lead to inefficiencies. For example, the Fisheries Act does not consider rainwater. This means the regulatory architecture managing rainwater is separated from the management of wastewater effluent, hampering a co-ordinated or integrated approach.

At the provincial level, regulatory provisions stem from other origins. In Quebec, for instance, wastewater management is regulated from an environmental perspective. Different origins of regulations translate into different levels of ambition or assessment of appropriate levels of water quality. Federal standards do not consider the dilution capacity of receiving water bodies: the same level of effluents may be safe for the environment in a water-abundant river or lake, but harmful where water is scarce. The ongoing revision of environmental licences in Quebec provides for local adjustment of standards: effluent levels account for the dilution capacity of the milieu. Differences in approaches explain the lack of consistency of federal and provincial regulations as regards wastewater management.

4.2. The Canada-wide Strategy for the Management of Municipal Wastewater Effluent

The Canada-wide Strategy for the Management of Municipal Wastewater Effluent was endorsed by the CCME in 2009. It aims to facilitate a harmonised approach to wastewater management across governments and provide regulatory certainty to municipal wastewater facility owners. The strategy requires that all municipal, community and government wastewater facilities achieve minimum national performance standards – minimal requirements for effluent quality, equivalent to secondary treatment of wastewater streams. The strategy further requires facilities to develop site-specific effluent discharge objectives to address specific substances that are of concern to a particular discharge or environment. The strategy foresaw that its requirements would be incorporated into federal, provincial and territorial regulatory frameworks. Three provinces/territories did not endorse the strategy: Newfoundland and Labrador, Quebec and Nunavut. Quebec, for example, helped draft the strategy and shares the objectives. However, it is concerned about financial implications and encroachment on provincial affairs. Municipalities have not been directly involved in the development of the strategy.

The Municipal Wastewater Effluent Coordinating Committee, established in 2009, is a forum to discuss long-term planning, co-operative work and issues related to the implantation of the strategy. The committee includes a representative from each jurisdiction, as well as an observer from the Table of Provincial/Territorial Deputy Ministers Responsible for Local Government.

4.3. National standards for wastewater treatment

Under the framework of the Canada-wide strategy, the federal government adopted Canada's first-ever national standards for wastewater treatment: the Wastewater Systems Effluent Regulations (WSER) in 2012. These regulations, established under the pollution prevention provisions of the Fisheries Act, set national baseline effluent quality standards on carbonaceous biochemical oxygen demand (CBOD), suspended solids, residual chlorine and un-ionised ammonia. These standards are achievable through secondary wastewater treatment. The WSER benefited from wide consultations with provinces, territories, municipalities, Indigenous communities and other interested parties.

The WSER include risk-based compliance timelines for those systems requiring upgrades to achieve secondary treatment. Deadlines to comply are quite generous for lower risk systems: some systems have until 31 December 2040 to meet effluent quality standards for CBOD and suspended solids. Such delays may, however, imply continued pressure on water quality in receiving water bodies. The regulations specify requirements for monitoring, record-keeping, reporting and toxicity testing. Regulatory reporting information from wastewater system owners and operators is housed in the Effluent Regulatory Reporting Information System (ERRIS), an electronic reporting system. Municipalities that do not comply are subject to penalties.

The WSER apply to owners and operators of wastewater systems that discharge effluent to fish-bearing waters and that collect an average annual daily volume of influent of 100 m^3 or greater (including municipal, private and federal wastewater systems). It also applies to systems owned or operated by Indigenous communities. Overall, some 2 560 of the 3 000+ wastewater treatment systems in Canada are subject to the WSER.

WSER do not apply to small systems under the 100 m^3 threshold. Nor do they apply to systems operating under extreme conditions, including in the Northwest Territories, Nunavut, or north of the 54th parallel in Quebec, Newfoundland and Labrador. Finally, they do not apply to wastewater systems that are located on the site of an industrial, commercial or institutional facility if the wastewater system is designed to collect influent whose volume consists of less than 50% blackwater and greywater combined. Deposits from wastewater systems not subject to the WSER may be regulated by provinces, or the federal government under the Fisheries Act. Quebec, for example, regulates systems above 10 m^3, anticipating shifts towards small-scale, decentralised systems.

Progress towards compliance has been slow. This mirrors the scale of the challenge and, possibly, the reliance of progress on access to federal funding. Hundreds of wastewater systems are thought to require upgrades to meet the requirements of the WSER. The cost of compliance is estimated at CAD 5.5 billion (in present value terms); ECCC estimates the monetary benefits of the regulation – essentially avoided health and environmental costs – at CAD 16.5 billion (in present value terms). The WSER have therefore triggered financing requests from municipalities. Recent increases in federal budgets for infrastructure development can accelerate progress (see Section 5).

Some progress has been made towards a harmonised framework. The WSER have strengthened the policy framework, yet the adoption of the standard has been slow in some jurisdictions. Further, the WSER have created some duplication and misalignments with existing provincial and territorial regulation. A 2014 progress report of the Canada-wide Strategy showed that initial risk assessments are well underway and commitments to phase out sewer overflows have been implemented (Table 5.3). However, review of how provincial

Table 5.3. **Implementation of the strategy for management of municipal wastewater effluent**

	Assessing initial risk level for non-complying facilities	Overflows due to development will not increase	Harmonised requirements are incorporated into regulatory frameworks	Bilateral agreements are completed
Alberta	Yes	Yes	Ongoing	Ongoing
British Columbia	partially	Yes	Ongoing	Ongoing
Manitoba	partially	Yes	Yes	Ongoing
New Brunswick	Yes (some issues)	Yes	Yes	Draft
Northwest Territories	na	Yes	na	na
Nova Scotia	Yes	Ongoing	Ongoing	Ongoing
Ontario	Yes	Yes	Yes	Ongoing
Prince Edward Island	Yes (full compliance)	Yes	Ongoing	Ongoing
Quebec[1]				Ongoing
Saskatchewan	Yes (some issues)	na	Ongoing	Draft
Yukon	Yes (full compliance)	na	Ongoing	Draft

1. Quebec has not signed onto the strategy, but adheres to its objectives.

regulations align with the new federal standard is time-consuming and progressing only slowly. This impacts the establishment of bilateral agreements between federal and sub-national jurisdictions. The possibility of "equivalency agreements" has provided an incentive for provinces to develop regulations that match federal ambitions, and thus can substitute for federal standards.[6] In addition, bilateral agreements can be reached to reduce administrative burden and set out procedures for co-operation between federal and provincial regulators. To date, agreements have been established with New Brunswick (2014), Yukon (2014) and Saskatchewan (2015). Discussions are ongoing with most interested provinces; an agreement with Quebec was drafted in 2015, but has yet to be finalised.

In addition to the strategy and new regulation, specific actions target selected lakes and rivers (e.g. Lake Winnipeg basin, Canadian Great Lakes, St. Lawrence River) in partnerships with provinces or with the United States. In 2005, Quebec, Ontario and the eight US Great Lakes states signed the Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement. It has been an important regional and international initiative led by provinces.

4.5. *Urban wastewater in the context of adaptation to climate change*

The federal government supported the development of a guide for municipal climate adaptation, as well as a risk-based guide for local governments in 2010 to help local governments address climate change. In addition, Budget 2016 provides CAD 75 million to the FCM for municipally-led projects that support the assessment of local climate risks and the integration of these impacts into asset management plans[7], as well as to identify and implement greenhouse gas (GHG) reduction strategies (GoC, 2016). In so doing, Canada is well-aligned with most OECD member countries, where policy responses to adaptation to climate change are often limited to mapping risks and raising awareness. Much more could be done, in particular to finance investments in water security in the context of adaptation to a changing climate. The Pan-Canadian framework on Clean Growth and Climate Change (Chapter 3) also supports investment in climate-resilient infrastructure, which includes wastewater. Box 5.3 highlights selected international experience with promoting adaptation of storm and wastewater management to a changing climate.

Box 5.3. **Adapting storm and wastewater management to a changing climate**

Several OECD member countries are providing adaptation guidance to local governments, businesses and the general public. This has been a particular focus for countries taking a decentralised approach to adaptation.

In ***Denmark***, for example, all 98 municipalities were required to conduct a climate change adaptation plan before the end of 2013. This plan contains a risk-mapping of the entire surface area in each municipality for flood events from all water sources. Flood risk mappings from rain events, sewer systems, creeks, sea and groundwater will be merged with a value-distribution mapping to generate the local risk-map. The Danish government released the tools needed to conduct the mapping for the disposal of the municipalities in January 2013. In addition, a law passed in 2012 allows municipalities to ban construction in certain areas solely due to climate change adaptation reasons. As such, it provides municipalities with a legislative foundation for local city planning directly connected to climate change adaptation.

In ***Norway***, the Oslo Water and Wastewater Department developed the "Midgard Snake" project to address pressure on the water mains and increased risks of flooding and water damage resulting from increased urban development and increasing precipitation due to climate change. The Midgard Snake (finished in 2014) functions as an interruptive drainage system, preventing polluted water from reaching the Oslo Fjord. The tunnel (with a capacity of 50 000 m^3) is both a transport route and a retention reservoir, storing water if the purifying plant lacks capacity. The project is designed to improve water quality in the fjord, address climate change impacts and reduce energy consumption (because the water is not being transported as far as it was previously).

The Climate Ready Water Utilities Initiative in the **United States** was developed by the US Environmental Protection Agency to assist water and utilities in becoming "climate ready". It supports implementation of plans and adaptation strategies at water and wastewater utilities that account for potential climate change impacts and build water sector resilience. In **New Zealand**, the government provides technical manuals, summary publications and guidance to inform local governments, businesses and individuals. Japan, Spain, Sweden and the United Kingdom take a similar approach.

Source: OECD (2013). Country profiles are available at *www.oecd.org/environment/resources/water-and-climate-change-adaptation-9789264200449-en.htm*

5. Financing investment in urban wastewater management

Urban wastewater management needs substantial and long-term financing to upgrade existing systems and adapt to forthcoming challenges. To date, prevailing sources of finance have relied heavily on federal and provincial programmes. A stronger reliance on predictable sources of finance such as tariffs for wastewater collection and treatment, and secured funding for storm water management, would put the sector on a more robust financial path. Economic instruments can also minimise investment needs in the future by promoting water-wise behaviour from water users, water utilities, property developers and city planners.

5.1. *Investment is needed to renew ageing infrastructure and adjust to new regulation*

Infrastructure for urban water management in Canada is publicly owned. Storm and wastewater management infrastructure represents the second largest category of capital investment in Canada (NRCan, 2008). In 2012, the Canadian Infrastructure Report Card

estimated the current value of Canadian water assets to be CAD 362 billion. Municipalities account for more than 80% of capital spending in environment and water systems. As of 2000, water and wastewater systems made up approximately 30% of Canada's municipal infrastructure stock (Mirza, 2007).

The state of wastewater and rainwater collection and treatment infrastructure has improved significantly compared to the mid-1990s. At that time, two-thirds of sanitary and combined sewers and a majority of sewerage treatment plants and storm sewers were not operating at an acceptable level (Mirza and Haider, 2003). Twenty years later, the situation has improved, but remains fragile. On the one hand, the 2016 Canadian Infrastructure Report Card estimates that two-thirds of Canada's urban wastewater infrastructure is in very good (39%) or good (26%) physical condition. The remainder is estimated to be in fair (24%), poor (8%) or very poor (3%) condition, and requires upgrade and replacement. On the other hand, estimated annual reinvestment levels range from 0.7% to 1.4% of current assets. At such rates, it would take between 71 and 140 years to renew existing assets. This far exceeds the life expectancy of many pipes and appliances and will result in wastewater assets decaying over time (CIRC, 2016).

ECCC estimates that compliance with the WSER will cost CAD 5.5 billion. Operators in Quebec, British Columbia and Atlantic Canada are expected to shoulder the largest share. This figure does not include investments to accommodate population growth, adapt to climate change or improve service. The five largest infrastructure projects underway or in planning represent over CAD 2 billion in investment in wastewater management upgrades (CIRC, 2012). In Quebec alone, the cost for addressing sewer overflow and treating effluents is projected to be CAD 9.5 billion over the next 30 years (CAD 6.2 billion for the former, and CAD 3.2 billion for the latter) (Gouvernement du Québec, 2013).

5.2. Local funding: Tariffs and fees for water services

Most provinces levy licence fees to major water users to access the resource. However, these fees are not set in accordance with any pricing principles, but rather derive from the cost of administering the licensing programme. As such, they cannot promote efficient water use.

The use of pricing instruments for urban wastewater management – notably tariffs for wastewater services – is widespread. All municipalities levy charges to water users, with an increasing number applying volumetric charges. This has helped reduce residential water consumption, which nonetheless remains one of the highest in the OECD (see Chapter 1). A large heterogeneity in tariffs exists for water services across provinces and territories. A 2009 survey on municipal water pricing indicates that (ECCC, 2011b):

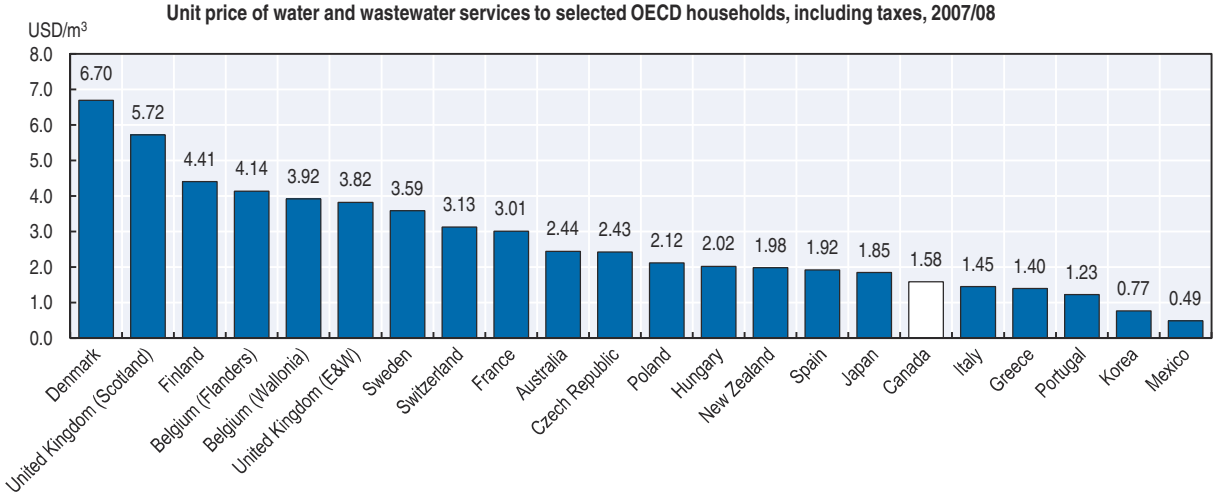
- Residential metering increased from 63% to 72% over 2006-09.
- An estimated 80% of residential clients pay for water through volumetric rates (up from some 55% in 1991). But there are large variations across provinces: for example, in Newfoundland and Labrador, most residents pay a flat charge (Renzettti and Dupont, 2017).
- The most common volumetric rate is a constant unit charge. The use of increasing block tariff (where unit cost increases by tranche) has decreased since 2004, essentially as Toronto shifted from a block tariff to constant unit charge.
- Average residential volumetric rates for water and sewer increase with levels of consumption. A three-person household consuming 25 m^3/month would pay about CAD 53 in 2009 (up 24% since 2006). Average monthly bills range from CAD 22 in Quebec to nearly

CAD 75 in New Brunswick. The result for New Brunswick reflects higher level of per capita consumption.

- As in most OECD member countries, sewer charges represent approximately half of the total charge for water and sewer services. Their share is higher in larger municipalities. This may reflect the higher cost for more advanced treatment in larger municipalities.

The level of tariffs for wastewater services is too low to generate the revenues needed to cover the cost of urban wastewater management, or to provide incentives to minimise future infrastructure needs. Canadian municipalities are far from recovering the full cost of the service and the full environmental cost through prices (ECCC, 2011b). Affordability is not the main obstacle to robust pricing strategies, as Canada ranks at the low end of water rates in OECD member countries (Figure 5.5). With the exception of Ontario, Canadian provinces lack regulation to promote recovery of costs for municipal water supply and sanitation services through tariffs (Renzetti and Dupont, 2017).

Figure 5.5. **Canada ranks at the low end of water rates among OECD member countries**



Note: OECD estimates based on country repllies to the 2007-08 survey or public sources validated by the countries; see OECD (2010), "*Pricing Water Resources and Water and Sanitation Services.*

StatLink http://dx.doi.org/10.1787/888933566039

In June 2015, CCME identified a set of options to guide a jurisdiction if it chooses to develop a water pricing framework. Governments can use these water pricing principles to develop or improve their policies in light of their particular circumstances and objectives. The options are listed under two themes: Influencing the Behaviour of Water Users and Generating Public Revenue.

Asset management plans are increasingly popular among Canadian municipalities, and have increased knowledge of infrastructure needs and costs. This has led to growing use of mechanisms that allow municipalities to allocate revenues to cover associated costs of services more fairly and accurately. Several municipalities have set up specific instruments to finance storm water collection and treatment. These include specific user fees levied on property owners based on the amount of rainwater run-off generated by their property (or on the surface of the property). Such fees can discourage constructions that increase run-off, while securing revenues for municipalities to build and operate storm water management systems. In combination with green infrastructure, they provide

a cost-efficient option to manage rainwater in a resilient way. The growing use of storm water user fees partly results from the diffusion of asset management plans among Canadian municipalities.

The increase of wastewater tariffs to cost-recovery level and the diffusion of storm water management fees can remedy the decline of revenues of water utilities in Canada, which occurred along with the decline in domestic water consumption. They are part of a menu of options to secure revenues for water services, decoupled from the volume of water sold (OECD, 2015c).

5.3. *Federal and provincial investment*

As the level of cost recovery through tariffs is low, governments (co-)finance a significant part of operation and maintenance costs of water infrastructure, as well as investment in water infrastructure renewal or expansion. Such high reliance on federal or provincial funding could generate risks of underfunding if public finance becomes scarce and contested. In addition, it provides no incentive to local governments to harness additional sources of finance (e.g. through tariffs) and to manage assets properly.

Public funds for urban wastewater management

Several federal programmes channel public funds to investment in urban water management. Such fragmentation, however, encourages an opportunistic approach from provinces and municipalities. It does not guarantee the most efficient contribution of public budgets to national priorities. Some of these programmes are described below.

The Gas Tax Fund (GTF) provides CAD 2 billion annually in funding for Canadian municipalities to build and revise local public infrastructure, including for water and wastewater. Funding is provided up-front to provinces and territories, which forward it to municipalities to pool, bank and borrow against. As of March 2016, CAD 2.5 billion had been spent towards wastewater infrastructure projects, about 15% of total investment under the GTF. Wastewater infrastructure is also eligible under several of Infrastructure Canada's programmes. Since 2002, it has provided almost CAD 3.3 billion for wastewater infrastructure projects across the country. The Great Lakes Sustainability Fund provides technical and financial support (up to one-third of the total cost of projects) to complete the clean-up and restoration of locally degraded areas, including support to innovative approaches to improve municipal wastewater effluent quality.

Through Budget 2016, the federal government began providing CAD 5 billion over five years for investments in water, wastewater and green infrastructures. This includes the creation of a new CAD 2 billion Clean Water and Wastewater Fund for provinces, territories and municipalities to spend on immediate improvements. The Lions Gate Wastewater Treatment Plant, for example, received CAD 212 million to upgrade secondary treatment standards and make them more climate-resilient. In addition, Budget 2016 provides CAD 3.4 billion over five years for social infrastructure, including water efficiency of social housing. These levels of funding signal an effort to accelerate the improvement of wastewater collection and treatment, after the adoption of the WSER.

The Green Municipal Fund (CAD 550 million) provides loans and grants through the FCM to finance upfront costs of municipal projects, including urban water management. It also provides knowledge services. Typical expenditures cover feasibility studies, pilot or small-scale developments. In 2016, the federal government added CAD 125 million to the

fund. According to the fund's database, 150 wastewater and storm water projects have been completed or are ongoing since 2000. This includes 68 feasibility studies.

Provinces also develop investment support programmes that benefit wastewater treatment, often in conjunction with the federal budget. Under Alberta's Specified Gas Emitter Regulation, for example, wastewater treatment plants can apply for carbon offset credits using the Quantification Protocol for Anaerobic Treatment of Wastewater Projects. The Canada-Quebec agreement on the fund for water supply and wastewater treatment (FEPTEU, in French) allocates CAD 364 million of federal funding; Quebec is expected to contribute CAD 300 million. The fund supports projects listed in the provincial infrastructure plan for 2016-26.

Ensure high returns on public money

The benefit of public expenditure depends on how investment projects are selected and how opportunities to harness other sources of finance have been explored. OECD (2016b) highlights four inter-connected sets of actions that can increase the scale and effectiveness of investment in water security:

1. Maximise the value of existing assets for water security investments. The operational efficiency and effectiveness of existing infrastructure and service providers postpone investment needs and are a requisite to further investment. It is not clear how public financing schemes in Canada ensure that new projects have been assessed against the potential benefits of improved operation and maintenance. Nor is it clear how they factor in the capacity to adequately operate and maintain new developments.
2. Select investment pathways that maximise the performance of urban wastewater management returns over time. This requires performing rigorous triple bottom line analysis on sequences of projects and carefully considering how pursuing a specific project may foreclose future options. Such analysis is best performed at watershed level. CWWA reports that this may not happen in Canada; available funding is not always apportioned by asset classes and prioritised by impacts and risks. Some municipalities address highly visible projects such as transit and may not focus enough on wastewater infrastructure.
3. Ensure synergies with investments in other sectors. In particular, investment in urban wastewater management needs to be harmonised with urban development, land use and related policies at watershed level. In that perspective, regional land-use planning in Alberta is an interesting approach that could inspire other provinces. The province's regional plans use environmental management frameworks to manage the cumulative effects of development. These, in turn, manage air, water and biodiversity to established thresholds and help build relationships with Indigenous peoples.
4. Scale-up financing through improved risk-return frameworks. Governments can help by enabling public and private actors (including water users) to earn returns commensurate to the risks they take. There is little evidence of attempts to attract private finance in Canada (be it revenues from water tariffs, or contributions from property developers). Anecdotal indication suggests that municipalities only consider action when federal and provincial funds are secured. There is a risk that such a financing strategy crowds out other sources of finance.

Some stakeholders reported limitations of the prevailing use of public money for urban wastewater management in Canada under current disbursement procedures for

Infrastructure Canada's funds. In Quebec, for example, the Ministry of Environment reviews plans and budgets submitted by municipalities, but the Ministry of Municipal Affairs (MAMOT) provides access to federal financial support. While the two ministries collaborate on accessing Infrastructure Canada funding, ECCC is not directly consulted on project selection (neither are regional watershed organisations). Projects selected by MAMOT therefore do not necessarily reflect the Ministry of Environment's priorities. MAMOT has set priorities; water supply and sanitation comes first: a municipality can only access financial assistance for projects in other domains (e.g. transportation) when water supply and sanitation objectives are met. These rules allow ranking priorities for each municipality, but not across municipalities, which would allow for channelling resources to where they would yield the largest environmental benefits. Municipalities have access to funds on a first come, first served basis. The process does not necessarily rewards projects with best value for money or those that accrue the most to the community. These deficiencies create a risk that selected projects may not align with federal priorities and may not fit into a co-ordinated approach at watershed level.

6. A role for innovation

Business-as-usual solutions have limited capacities to deliver reliable wastewater treatment under conditions of a changing climate in Canada. In response, some provinces and cities are exploring more innovative options. For instance, Alberta is drafting a Reuse and Storm Water Use Policy, expected to be completed by Fall 2017. However, the diffusion of innovative options seems limited. The 2011 Municipal Water Pricing Report indicates that less than 20% of the Canadian population lives in municipalities that reuse waste- or storm water (ECCC, 2011b).

Jurisdictions in charge of urban wastewater management would benefit from systematically exploring approaches that combine technical and non-technical innovations, from apartment to municipal scale and beyond, for storm and wastewater management. In relevant contexts, and when properly managed, these approaches can achieve high performance and adapt to a changing climate at least cost for the community. Such innovations can scale up to needs, minimise investment needs and avoid technical path dependency.

Localised, on-site systems, for example, can collect, treat and reuse wastewater at plot level, for both individual or small groups of properties. They require less up-front investment than larger, centrally piped infrastructures and are more effective at coping with the need to expand services (USEPA, 2002). They can also recover nutrients and energy (Matsui et al., 2001). Another option is the growing use of "source control" technologies that handle storm water near the point of generation. For instance, green roofs or pervious surfaces capture rainwater before it runs on polluted pavements and streets. Localised rainwater collection can be combined with grey water recycling, and even recycling of sewage water at source.

Innovation need not be high-tech. Proven technologies can change the way urban water is managed in cities, potentially contributing to higher levels of security, at least cost for society. They operate best when combined with non-technical innovation related to business models or design. Water-sensitive urban design, for example, considers how to enhance water security and access to water services at minimal cost for the community, including financial, social and environmental costs. Sustainable urban drainage systems (SUDS), for example, disconnect storm-water drainage from the sewer system and use the

green infrastructure of the urban landscape to store, filter and evaporate the storm water within the local catchment area (Mguni et al., 2015). In practice, SUDS supplement existing sewer system capacity, address flood risks and increase resilience in the face of climate change. This approach is gaining traction in selected municipalities in Canada.

Table 5.4. **Green infrastructure solutions for water resources management**

		Water quality regulation			Moderation of floods			
	WSS[1]	*Water purification*	*Biological control*	*Water temperature control*	*Riverine flood control*	*Urban storm-water runoff*	*Coastal flood (storm) control*	Protection of ecosystems
Green infrastructure solution								
Demand management	x							x
Local processing of black or grey water	x	x	x					
Wetlands restoration/ conservation	x	x	x	x	x			x
Constructing wetlands	x	x	x	x	x			x
Water harvesting	x					x		
Green spaces	x	x		x		x		x
Permeable pavements	x	x				x		x
Green roofs						x		x
Protecting/restoring mangroves, coastal marshes, dunes, reefs							X	x
Corresponding grey infrastructure (primary service level)								
Dams, groundwater pumping	x			x				
Dams, levees				x	x			
Water distribution systems	x							
Water treatment plant		x	x					
Urban storm water infrastructure						x		
Sea walls							X	

1. WSS = Water supply and sanitation. Includes drought.
Source: adapted from UNEP (2014), OECD (2013b).

In Canada, Ontario and Alberta are paving the way. Alberta is developing regulations, technical standards and guidelines to facilitate the safe use of reclaimed wastewater, in particular for fracking. It is thus creating a market (and a demand) for reclaimed water. Ontario supports demonstration projects to prove concepts and innovative technologies (Box 5.4). Other instruments include financial incentives for water users or property developers, and regulation through building and construction codes that mandate rainwater collection and minimising run-off at lot level.

Innovative solutions face a number of barriers. For example, even though the WSER do not prescribe specific technologies, federal funding schemes implicitly favour centrally piped infrastructure; these are accessible to municipalities. It is more difficult to finance a myriad of small-scale initiatives, under the remit of individual water users or property developers, such as green roofs to minimise run-off, or rainwater harvesting. Such barriers must be overcome to allow more innovative options to be systematically adopted. The case study of San Francisco illustrates how decentralised water management best materialises when combined with a series of adjustments (see Box 5.5).

OECD cities that have overcome barriers to the dissemination of alternative urban wastewater management have usually combined several initiatives:

- A long-term vision of water challenges and opportunities for urban development, combining policies beyond urban wastewater management. For instance, in Germany, municipalities

Box 5.4. **Stimulating innovative storm water management in Ontario**

The traditional approach to storm water management in Ontario is an efficient underground storm sewer network to convey urban run-off as quickly as possible to a nearby water body. In older parts of some cities such as Toronto's downtown core, storm water is conveyed with raw sewage in a combined sewer network to a wastewater treatment plant. The increase in impervious surfaces, combined with traditional storm water management, has significantly altered the movement of water in urban areas. The changes in the total volume, frequency and duration of rain events and the peak flow rate of storm water have increased erosion of river banks, as well as the potential for floods.

In response, Ontario's approach to storm water management now focuses on flood control: it addresses run-off volume, peak flow and quality, and factors such as temperature control, infiltration, water budget and fish habitat. Some practices also address run-off duration and frequency, considering Ontario's seasonal challenges such as spring snowmelt. The use of a "treatment train approach", which incorporates source (e.g. disconnected downspouts, rain barrels, rain gardens), conveyance (e.g. swales, exfiltration systems) and end of pipe control (ponds, engineered wetlands) to manage storm water, is encouraged. Sixteen storm water projects in Ontario received funding under the Showcasing Water Innovation programme to stimulate innovative research, and ultimately to help municipalities manage storm water better. For example, Lake Simcoe Region Conservation Authority was awarded a grant to retrofit existing storm-water ponds to include quality control. This will yield important information to other municipalities, as storm-water ponds are extensively used throughout Ontario.

The city of Toronto encourages green infrastructure through several instruments, including a green roof by-law, an eco-roof incentive programme, a green standard for sustainable site and building design, a Wet Weather Flow Master Plan and a downspout disconnection programme.

Source: WaterTAP (2013).

Box 5.5. **Decentralised water management in San Francisco**

As with many other US cities, San Francisco also faces dwindling water supplies, long-lasting droughts and extreme weather events. Most of its options for new water supplies and control strategies tend to be controversial and expensive, urging the city to evaluate new ways to collect, treat and reuse local water resources. The San Francisco Public Utilities Commission (SFPUC) is therefore embracing decentralised water treatment systems to provide supplemental water and wastewater services.

It launched the Non-potable Water Program, a local programme for regulating on-site water use (there are no national standards for on-site systems using alternate water sources such as rainwater, storm water, grey water and black water in the United States). The programme creates a streamlined process for new developments to collect, treat and reuse alternate water sources for toilet flushing, irrigation and other non-potable uses. Additionally, the programme establishes guidelines for developers interested in installing non-potable water systems in buildings and local regulations to ensure appropriate water quality standards.

Subsequently, the SFPUC realigned governmental policies and created a new regulatory framework. It collaborated with the city's Departments of Building Inspection and Public Health to develop a permitting, review and approval process for on-site system installation

Box 5.5. **Decentralised water management in San Francisco** *(cont.)*

and operation. SFPUC served as: a) programme administration (providing outreach, technical and financial assistance); b) cross connection control (protecting the public water supply, including backflow prevention, testing, certification and tracking); and c) a water use calculator to help developers estimate the volume of the on-site non-potable supplies and demand available for their project.

The Non-potable Water Program allowed for micro-markets to emerge when two or more buildings share, buy or sell water without the public agency providing the service. The programme shifts the burden of operation, maintenance and water quality compliance to the private sector. At the same time, the public sector maintains oversight to ensure the protection of public health and the public water system. The move towards smaller on-site water systems holds great promise for reducing fresh water demands, aiming to building a more resilient and sustainable city.

Source: OECD (2015c).

combine responsibilities for spatial planning and development control for the provision of water services, including surface water drainage.

- Economic instruments and business models for water utilities and land development that factor in externalities related to water security. Well-designed tariffs can reflect some of the benefits of enhanced water security and improved water services.
- Governance structures that favour a whole-of-government approach to urban water management and reach beyond city limits. Canadian metropolitan areas provide opportunities to manage water at the appropriate scales.
- Information campaigns to raise city dwellers' awareness of water-related risks and the costs of liabilities that result from short-term visions.

In Canada, federal and provincial governments would benefit from joining forces in encouraging municipalities to systematically explore alternative ways to manage water, including urban wastewater. They could:

- Ensure that regulation and financing schemes do not prescribe any technology, or contribute to technological path dependency.
- Use regulation to encourage exploration of innovative (technical and non-technical) approaches. Land use, urban policies are particularly appropriate. Reflecting the full cost of water, including the opportunity cost of using freshwater, would create demand for reclaimed water. Clear quality standards for secondary uses of reclaimed water would eliminate regulatory uncertainty.
- Build confidence in green infrastructure. The government of Quebec proposes that green infrastructures benefit from the Environmental Technology Verification programme (ETV), just as grey ones have.
- Share information and award innovative cities. The federal government, together with partners such as the Canadian Water and Wastewater Association, developed and distributed materials to support education and encourage consumers to adopt sustainable water use practices. Such material could include reference to product stewardship. This would enable users to understand the costs associated with the release of harmful substances into domestic water flows. Additional action could be targeted towards the engineering community to promote green infrastructures.

Infrastructure finance can play an important part in the process. It can select projects that contribute to urban water security and adapt to a changing climate at the least cost. Infrastructure finance can contribute to water-sensitive urban design, attaching financial support to long-term, horizontal development plans that factor in climate change.

Recommendations on urban wastewater management

- Complete monitoring of the performance of wastewater management, and impacts on water quality, in places where information is lacking; improve consistency of monitoring frameworks across the country with a view to better identify hotspots and rank priorities.
- Invest in research to better understand the treatment efficacy of alternative technologies (including natural systems and wetlands), as well as the impact of effluent releases on wetlands' ecosystem health, under both normal and extreme climatic conditions. Build on that research to explore the possibility of expanding the coverage of the Wastewater Systems Effluent Regulations (WSER), across Canada, including northern territories.
- Expedite discussions on bilateral agreements between the federal government and provinces for the WSER as one possible way to trigger policy responses and adjust regulatory frameworks at provincial and territorial level; systematically explore opportunities to streamline and speed up negotiations.
- Ensure that conditions attached to provincial and federal infrastructure funds for urban wastewater management bring about the best value for money by incentivising municipalities to: i) make the best use of existing assets; ii) develop investment pathways that maximise water security returns over time; iii) ensure synergies and complementarities with investments in other sectors, especially urban development, land use, rainwater management or energy; and iv) scale-up their own financing capacities, for instance by harnessing water users (with tariffs for wastewater and rainwater services) or property developers (with taxes that capture some of the rent accrued from improved water security).
- Increase tariffs for water and/or wastewater services to at least recover the operation and maintenance cost of wastewater collection and treatment.
- Systematically reflect the impacts of climate change on water availability and demand in all urban water management plans, infrastructure design and investment programmes across levels of government. Risks of heavy rains and urban floods deserve particular attention.
- Encourage innovative approaches to urban water management, by ensuring that financial support and regulation are not technology-prescriptive and can actively contribute to the diffusion of innovative and green infrastructure solutions, as appropriate; use federal funding to encourage cities to explore water-wise urban development (such as green roofs or permeable pavements) as potentially cost-effective, climate-resilient responses to heavier storms triggered by a changing climate.
- Further study risks associated with emerging pollutants, and explore cost-effective policy responses, including by raising public awareness on their effect on wastewater streams, with a view to avoid dumping. Other options build on new developments in monitoring techniques, such as effect-based monitoring.

Notes

1. The authors of the survey note that, because of sampling biases, this figure may be an underestimate. They also note that comparison with previous surveys is inappropriate because of changes in methods.
2. Secondary treatment removes over 95% of the total mass of conventional pollutants in wastewater (i.e. carbonaceous biochemical oxygen demand, suspended solids and nutrients). Significant amounts of non-conventional pollutants and bacteria that are present may also be removed through such treatment. Secondary treatment suffices to meet standards for wastewater effluents.
3. See *http://ottawa.ca/en/city-hall/planning-and-development/construction-and-infrastructure-projects/sewers-water-and/under-2* for more information.
4. The Ministry of Infrastructure and Communities develops a ten-year plan to deliver significant new funding to provinces, territories and municipalities. The plan focuses on green infrastructure (including investments in local water and wastewater facilities), clean energy, climate-resilient infrastructure like flood mitigation systems, and infrastructure to protect against changing weather.
5. Budget 2016 proposes to provide up to CAD 19.5 million over five years, starting in 2016-17, to facilitate Canada's portion of funding regarding the response to several studies on bilateral water issues.
6. Under the federal Fisheries Act, the federal government can agree *not* to apply its regulations in a province or territory, if it agrees that provincial regulations in that province provide "equivalent" protection.
7. CWWA projects that within ten years, every municipality in Canada will likely have an asset management plan in place. Some provinces, such as Ontario, already require all their municipalities to have one.

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ANNEX 5.A

Canadian and EU water framework directive guidelines for water quality

The European Water Framework Directive (WFD) sets an objective of good ecological status of water bodies. This compares with the Canadian definition of water quality guidelines for the protection of aquatic life.[1] Some comments apply before the two standards can be compared.

Water quality essentially is a provincial jurisdiction in Canada: provinces have their own regulations and standards. To measure water quality, the federal government uses the Canadian Water Quality Guidelines (CWQGs) for the protection of aquatic life. The CWQGs provide science-based goals for the quality of aquatic habitats. Water quality is good when water quality measurements never or rarely exceed water quality guidelines and, when they do, it is usually by a narrow margin. Poor water quality is found when water quality measurements usually exceed water quality guidelines or exceed the guidelines by a considerable margin.

The European regulation endeavours to measure biological quality. It considers physicochemical and hydromorphological elements and takes undisturbed conditions as a reference. The Canadian standards measure whether physical and chemical characteristics of freshwaters are acceptable for aquatic life. Generic CWQGs figures set at national level may not capture local variation in water quality due to geography.

Another difference is that the European classification considers that if a water body does not meet one parameter, it fails ("One out, All out"). The Canadian policy considers the percentage of cases of non-compliance. It is usually considered that the "One out, All out" rule leads to an underestimation of the good ecological status in Europe. CWQGs tends to underestimate problems in some areas and overestimate problems in others. Table 5.5 compares the two standards.

Note

1. The characterisation of Canadian standards in this section owes to Martha Guy, ECCC (personal communication), who is gratefully acknowledged.

Comparison of Canadian and EU Water Framework Directive guidelines for water quality

WFD ECOLOGICAL STATUS CLASSES Normative definitions (Annex V)		CANADA ATTRIBUTE STATES Attribute tables – narrative attribute states	
High	The values for the biological quality elements reflect those normally associated with undisturbed conditions for that type and show no, or only very minor, evidence of distortion. There must be no, or only very minor, alterations to the values of the physicochemical (and hydromorphological) elements from those normally associated with undisturbed conditions for the type. Example – lake algae/plants and nutrients The taxonomic composition and abundance of phytoplankton, macrophytes and phytobenthos correspond totally or nearly totally to undisturbed conditions. The average phytoplankton biomass is consistent with the type-specific physicochemical conditions and is not as such to significantly alter the type-specific transparency conditions. There are no detectable changes in the average macrophytic and the average phytobenthic abundance. Planktonic blooms occur at a frequency and intensity consistent with the type-specific physicochemical conditions. Nutrient concentrations remain within the range normally associated with undisturbed conditions.	Excellent	Water quality measurements never or very rarely exceed water quality guidelines.
Good	There are low levels of distortion to the biological elements due to human activity, but the values must deviate only slightly from those associated with undisturbed conditions. The physicochemical conditions must support the biological values and ecosystem functioning. Example – lake algae/plants and nutrients There are slight changes in the composition and abundance of planktonic, macrophytic and phytobenthic taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of algae resulting in undesirable disturbance to the balance of organisms present in the water body or to the physicochemical quality of the water or sediment. A slight increase in the frequency and intensity of the type specific planktonic blooms may occur. The phytobenthic community is not adversely affected by bacterial tufts and coats present due to anthropogenic activity. Nutrient concentrations do not exceed the levels established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements. **WFD default objective is Good/Moderate boundary. A less stringent objective – the highest achievable – can be set based on disproportionate cost or technical infeasibility**.	Good	Water quality measurements rarely exceed water quality guidelines and, if they do, it is usually by a narrow margin.
Moderate	There are moderate levels of distortion to the biological elements due to human activity, and the values deviate moderately from those associated with undisturbed conditions. The physicochemical conditions are consistent with the biological values. Example – lake algae/plants and nutrients The composition and abundance of planktonic taxa differ moderately from the type-specific communities. Phytoplankton biomass is moderately disturbed and may be such as to produce a significant undesirable disturbance in the condition of other biological quality elements and the physicochemical quality of the water or sediment. A moderate increase in the frequency and intensity of planktonic blooms may occur. Persistent blooms may occur during summer months. The composition of macrophytic and phytobenthic taxa differ moderately from the type-specific communities and are significantly more distorted than those observed at good quality. Moderate changes in the average macrophytic and the average phytobenthic abundance are evident. The phytobenthic community may be interfered with, and, in some areas, displaced by bacterial tufts and coats present as a result of anthropogenic activities. Nutrient conditions consistent with the achievement of the values specified above for the biological quality elements.	Fair	Water quality measurements sometimes exceed water quality guidelines and may do so by a wide margin.
Poor	Waters showing evidence of major alterations to the values of the biological quality elements for the surface water body type and in which the relevant biological communities deviate substantially from those normally associated with the surface water body type under undisturbed conditions, shall be classified as poor.	Marginal	Water quality measurements often exceed water quality guidelines and/or exceed the guidelines by a considerable margin.
Bad	Waters showing evidence of severe alterations to the values of the biological quality elements for the surface water body type and in which large portions of the relevant biological communities normally associated with the surface water body type under undisturbed conditions are absent, shall be classified as bad.	Poor	Water quality measurements usually exceed water quality guidelines and/or exceed the guidelines by a considerable margin.

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