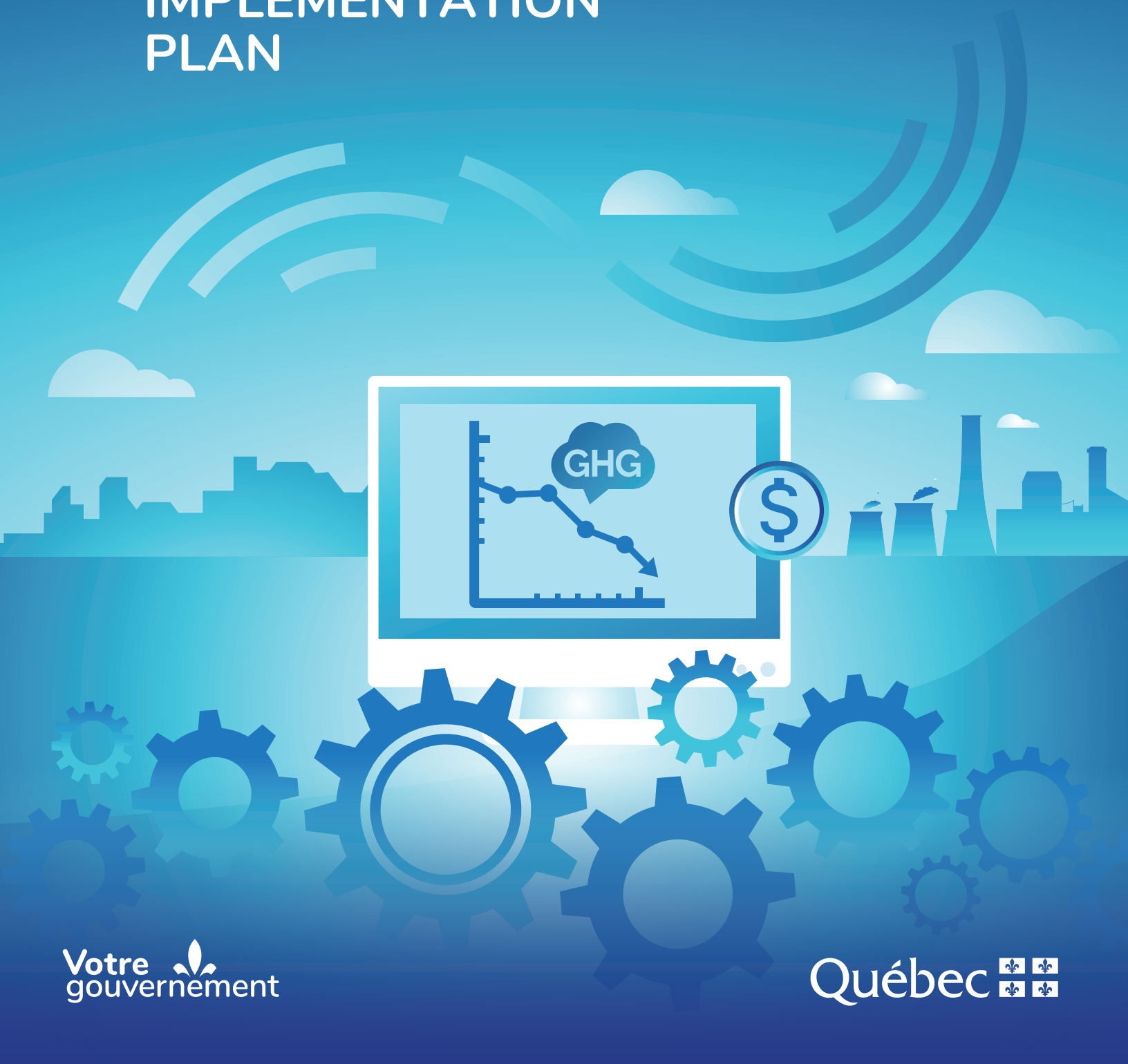
IMPACT ANALYSIS ON GHG EMISSIONS AND THE ECONOMY

2030 Plan for a Green Economy

2023-2028 IMPLEMENTATION PLAN



Votre gouvernement

Québec

IMPACT ANALYSIS ON GHG EMISSIONS AND THE ECONOMY

2030 Plan for a Green Economy

2023-2028 IMPLEMENTATION PLAN

May 2023

Québec

The Ministère des Finances and the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs produced this publication.

2030 Plan for a Green Economy – 2023-2028 Implementation Plan
Impact Analysis on GHG Emissions and the Economy

Legal deposit – May 19, 2023
Bibliothèque et Archives nationales du Québec
ISBN 978-2-550-94736-3 (PDF)

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Québec has set a greenhouse gas (GHG) emissions reduction target of 37.5% in 2030 compared to 1990 levels, which corresponds to an emission level of 53.3 million tonnes of CO_2 equivalent (Mt).

In the absence of government action to fight climate change, it is estimated that Québec's GHG emissions could be as high as 84.0 Mt in 2030, considering projected economic growth and technological change trends.

— The potential reduction effort to be achieved to fully meet Québec's target of 53.3 Mt would thus be 30.7 Mt.

❑ The defined initiatives make it possible to achieve 60% of the target in 2030

The entire array of defined initiatives should lead to reductions estimated at 18.3 Mt in Québec by 2030, i.e., 60% of the 30.7 Mt effort to be attained by 2030.

— This represents an increase in relation to the proportion of 51% presented when the *2022-2027 Implementation Plan* of the *2030 Plan for a Green Economy* was published.

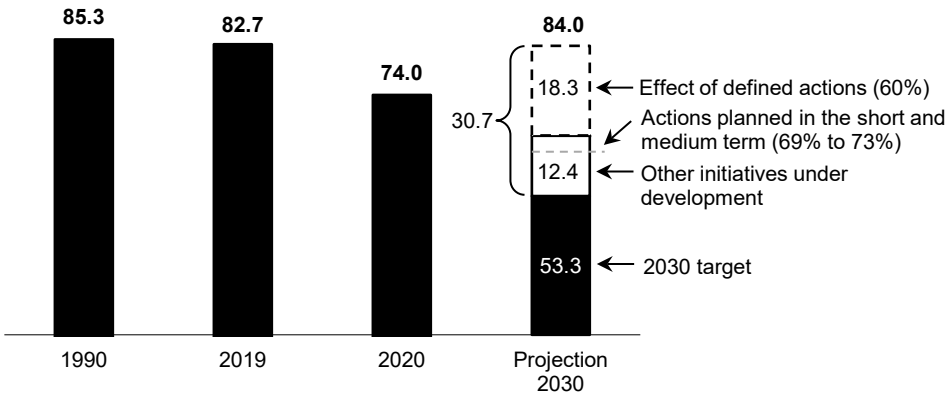
Moreover, other actions planned in the short and medium term (roadmap) would increase this proportion to reach between 69% and 73% of the necessary effort.

Besides, the evaluation of the reduction potentials modelled reveals that the overall reductions required to attain the 2030 target can be achieved in Québec by prioritizing the adoption of the least emissive technologies and adapting our lifestyle habits.

Other initiatives will be added in the context of the annual updates of the *2030 Plan for a Green Economy* to achieve all the requisite reductions to attain the target in 2030.

CHART 1

Level of effort required to achieve the 2030 target in Québec
(millions of tonnes of CO_2 equivalent and as a percentage of the reductions required to achieve the target)



Note: It is assumed that investments to combat climate change for the period 2028-2030 will continue under parameters like those presented for the period 2023-2028.
Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

INTRODUCTION

Climate change is a global challenge that is significantly impacting society, the economy, and the environment.

Therefore, all nations must act to reduce greenhouse gas (GHG) emissions and adapt to climate change.

Québec has set a greenhouse gas (GHG) emission reduction target of 37.5% in 2030 compared to 1990 levels, which corresponds to an emission level of 53.3 million tonnes of CO_2 equivalent (Mt).

— It also intends to pursue its longer-term efforts to achieve carbon neutrality (zero net emissions) by 2050.

To attain these objectives, Québec can rely on its electricity produced from renewable sources, but also on the implementation of significant initiatives under the *2030 Plan for a Green Economy* (PGE), including:

— the GHG emission cap-and-trade (CAT) system, which puts a price on carbon;

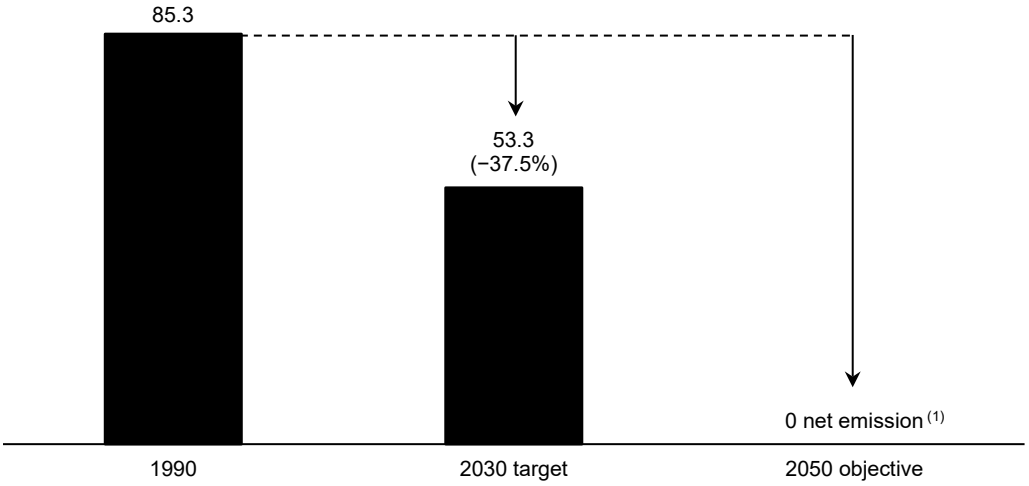
— the full reinvestment of revenues from the CAT system in measures in the PGE implementation plans through the Electrification and Climate Change Fund (ECCF);

— other legislation, regulations, and Québec government policies and initiatives, especially in the transportation, building, and industrial sectors.

These initiatives round out those announced by the federal government, the municipalities, the private sector, and the population overall.

CHART 2

Québec's GHG emissions in 1990 and reduction targets
(millions of tonnes of CO_2 equivalent and reduction in relation to 1990)



(1) Québec intends to make a longer-term commitment to achieve carbon neutrality by 2050.
Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

❑ Québec is in the vanguard of the fight against climate change

Québec is ahead of several jurisdictions in the realm of combating climate change and ranks first among the Canadian provinces with the lowest per capita GHG emissions.

— In 2020, per capita GHG emissions stood at 8.6 tonnes in Québec.

— In comparison, they were at 20.3 tonnes per capita on average in the rest of Canada and 10.5 tonnes per capita in the member nations of the Organisation for Economic Co-operation and Development (OECD).

❑ Taking stock of past achievements and the efforts to be made

In the short term, Québec's advance in the decarbonization of its economy can make additional reductions more costly in relation to those of other jurisdictions.

However, this advance can constitute a significant competitive advantage at the global level in a context where financial markets and consumers are increasingly supporting climate-responsible businesses.

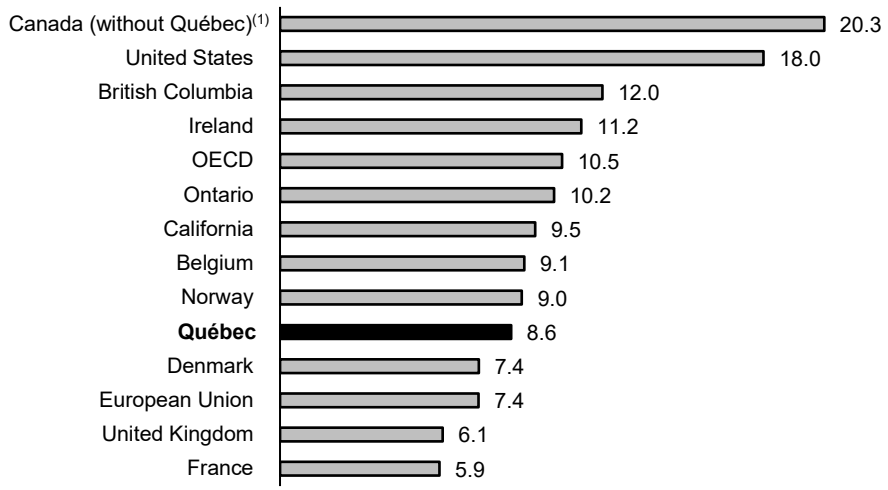
The Québec government will, therefore, continue to affirm its leadership in the fight against climate change and demonstrate exemplarity by reducing its carbon dioxide footprint.

— However, Québec's decarbonization cannot be fully achieved without the full participation of society.

To monitor the progress made and pinpoint the least costly reductions that allow it to attain its climate targets, the Québec government has committed to regularly updating its GHG emission projections and the impact of the defined reduction measures, considering the latest information available.

CHART 3

GHG emissions in Québec and elsewhere in the world – 2020
(tonnes of CO_2 equivalent per capita)



(1) In 2020, per capita GHG emissions in Canada stood at 17.7 tonnes when Québec is included.
Sources: Organisation for Economic Co-operation and Development, *United Nations Framework Agreement on Climate Change,* Environment and Climate Change Canada, United States Census Bureau, United States Environmental Protection Agency, Statistics Canada, and Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs.

GHG emission projection scenarios

Three separate simulations have been produced to support the Québec government's decision-making in the realm of the fight against climate change.[1]

- The **disengagement scenario** illustrates changes in GHG emissions considering economic growth and the technological enhancement trends in the absence of government intervention starting in 2021.
- The **reference scenario** shows the anticipated emission reductions stemming from the defined initiatives in Québec to combat climate change.
- The **reduction potential scenario** assumes the attainment of targets and illustrates the least costly ways of achieving the requisite reductions.

The Ministère des Finances du Québec and the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs have estimated the scenarios. Several Québec government organizations were also consulted in December 2022 in the context of the deliberations.

The disengagement scenario

The disengagement scenario allows for the projection of GHG emissions in the absence of government action to combat climate change, e.g., the GHG emission cap-and-trade system (CAT system), measures, and regulations starting in 2021.

This theoretical scenario provides an overview of the potential effort to be made to attain the reduction targets that considers the economic growth forecast by the Ministère des Finances du Québec and the underlying technological improvements. The scenario includes the emissions that would have occurred without government intervention.

The reference scenario

The reference scenario considers the defined initiatives to combat climate change. The projection illustrates the impact in Québec of:

- the CAT system price signal;
- measures in respect of which funding is planned under the implementation plans of the *2030 Plan for a Green Economy* (PGE);[2]
- new regulations in force since 2021 or about to be applied, and the initiatives of the federal government and the municipalities.

The models used consider the interplay between the CAT system and the other defined initiatives, thereby avoiding double counting in GHG emission reductions.

The choice of technologies illustrates the outcome projected by the modelling following optimization according to the entire array of economic and financial assumptions formulated, anticipated changes in behaviour, and the solutions available, e.g., energy efficiency, additional electrical capacity, and reduced output.

The reduction potential scenario

The reduction potential scenario illustrates, according to current knowledge, the least costly emissions reductions that allow for the attainment of Québec's 2030 target (optimization).

This scenario suggests the best way to reduce GHG emissions in Québec according to parameters such as the cost of current and future technologies, changes in the behaviour of households, and the possible adaptation of the structure of the economy in a future low-carbon Québec. It also considers constraints linked to growth in electricity supply by 2030.

1 Estimates throughout this document are based on the information available on March 10, 2023, and on the economic and financial forecasts of the Québec government's Budget 2023-2024. Appendix 2 indicates the main risks linked to the projection scenarios.

2 It is assumed throughout this document that investments to combat climate change for the period 2028-2030 will continue under parameters like those presented for the period 2023-2028.

1. EMISSION REDUCTION TARGETS: WHERE ARE WE NOW?

1.1 Québec achieved the reduction target for 2020

According to the *Rapport sur l'atteinte de la cible de réduction des émissions de GES du Québec pour l'année 2020*, Québec's net GHG emissions stood at 62.6 Mt in 2020, i.e., 26.6% below the 1990 level. This outcome stems from:

- a reduction in GHG emissions in Québec (−11.2 Mt);
- GHG emission reductions attributable to Québec but achieved outside the province (−11.4 Mt) in the context of the joint carbon market with California and according to the principles recognized by the Paris Agreement.

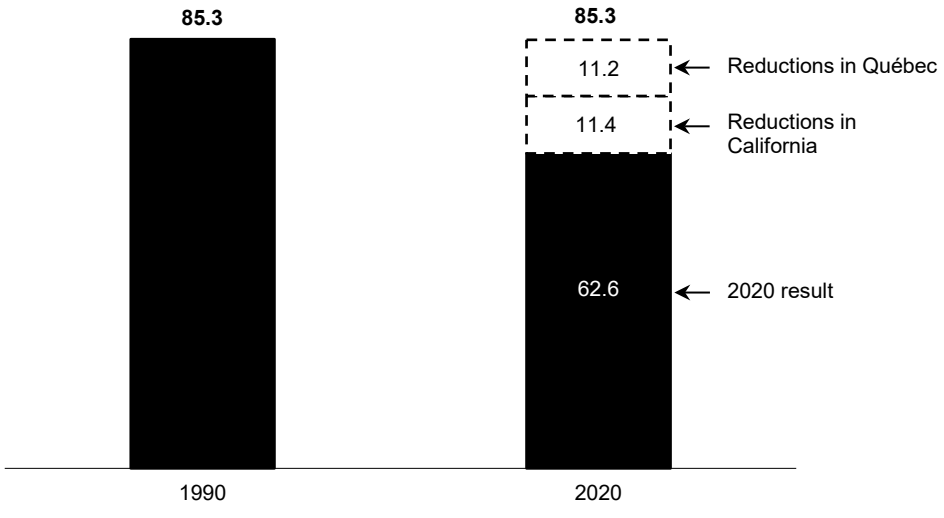
The reductions exceed the 20% GHG emission reduction target in 2020 in relation to 1990 that Québec set in 2009.

They result from the COVID-19 pandemic's temporary impact on the economy but also from the actions to combat climate change.

In the coming years, the government intends to implement initiatives that will allow for the attainment of the 2030 target while maximizing emissions reductions and positive economic impacts in Québec.

CHART 4

Québec's GHG emissions and the 2020 target
(millions of tonnes of CO_2 equivalent)



Note: Totals may not add due to rounding.
Source: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs.

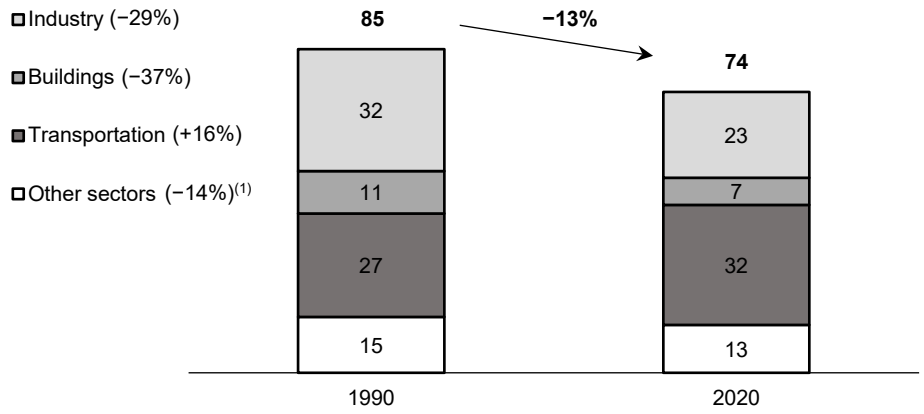
Québec's GHG emissions fell by 13% between 1990 and 2020

According to the Québec inventory of greenhouse gas emissions, Québec's emissions fell by 13% between 1990 and 2020 due, among other things, to temporary reductions stemming from the impact of the COVID-19 pandemic. This result is attributable to:

- a 29% reduction in industrial emissions, resulting among other things from the gradual replacement of industrial equipment and manufacturing processes, plant modernization, growing reliance on renewable or less emissive energy, and efficiency gains and production adjustments;
- a 37% decrease in emissions in the residential, commercial, and institutional buildings sector due to the electrification of residential heating and improved energy efficiency;
- a 16% increase in emissions from the transportation sector, stemming from:
  - a 167% increase in emissions from heavy-duty vehicles, used primarily for freight transportation;
  - a 4% increase in emissions from light-duty vehicles, due to a 125% increase in emissions from light trucks such as sport utility vehicles.

GHG emissions are expected to increase between 2020 and 2021, due primarily to the decrease in public health measures related to the COVID-19 pandemic and to faster growth in the Québec economy in 2021.[1]

GHG emissions in Québec in 1990 and 2020
(millions of tonnes of CO_2 equivalent, unless otherwise indicated)



Note: Totals may not add due to rounding. The figures in parentheses indicate the change from 1990 to 2020.
(1) The other sectors include agriculture, residual materials, and electricity generation and distribution.
Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

1 According to Environment and Climate Change Canada, GHG emissions in Québec increased by 4.3% in 2021 to reach 77.5 Mt. The Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs will release, by the end of 2023, the 2021 inventory of greenhouse gas emissions in Québec based on the most recent data available.

1.2 Economic growth: an upward effect on GHG emissions by 2030

Economic growth is usually accompanied by increased household consumption and business production, which can lead to higher GHG emissions.

— However, the effect of this increase on GHG emissions is mitigated by the continuous improvement of energy efficiency and practices in the economy, as well as by the replacement of equipment with less emissive systems.

Therefore, according to anticipated economic growth and technological improvements (disengagement scenario),[1] Québec's GHG emissions could increase by 1.3 Mt between 2019 and 2030,[2] to reach 84.0 Mt. This increase would stem from:

— increased emissions in the transportation sector (0.7 Mt) at a time when the impact of an increase in the number of motor vehicles appears to be mitigated by greater reliance on electric vehicles, which will become more affordable and accessible;

— increased GHG emissions in the industrial sector (0.9 Mt) due to growth in output in several industries;

— reduced emissions in the buildings sector (−0.4 Mt), where ongoing conversion to electric residential heating and improved energy efficiency are anticipated.

TABLE 1

GHG emissions projection – Disengagement scenario
(millions of tonnes of CO_2 equivalent)

	Level					Change
	1990	**2019**	**2020**	**2025**	**2030**	**2019-2030**
Transportation	27.2	36.5	31.6	36.3	37.2	0.7
Industry(1)	33.5	25.4	22.9	25.9	26.3	0.9
Buildings	11.2	8.3	7.1	7.9	7.9	−0.4
Residual materials	6.2	4.6	4.5	4.7	4.7	0.1
Agriculture	7.1	7.9	7.9	7.9	7.9	—
TOTAL	**85.3**	**82.7**	**74.0**	**82.7**	**84.0**	**1.3**

Note: The disengagement scenario illustrates potential changes in GHG emissions without government intervention starting in 2021. It considers economic growth and underlying technological improvements.
(1) This sector includes emissions related to electricity generation and distribution.
Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

1 The box on page 5 describes the scenarios.

2 The year 2019 has been used as a benchmark throughout this document since data for 2020 include the downward effects of the COVID-19 pandemic on GHG emission levels.

1.3 The initiatives defined or under development: up to 73% of the 2030 target

In the absence of government action to fight climate change, it is estimated that Québec's GHG emissions could reach an estimated 84.0 Mt in 2030, considering projected economic growth and technological change trends.

The attainment in Québec of the 2030 target would require a GHG emissions level of 53.3 Mt, which would require a reduction of 30.7 Mt in the projected level in 2030.

It is estimated that the entire array of initiatives defined and funded under the *2023-2028 Implementation Plan* will lead to a reduction in GHG emissions of 18.3 Mt in 2030, equivalent to 60% of the requisite effort (reference scenario).

— This represents an improvement in relation to the proportion of 51% presented in *The 2022-2027 Implementation Plan.*

The 18.3 Mt reduction stems from:

— the impact of the CAT system price signal on the behavioural change of households and businesses in Québec (6.0 Mt);

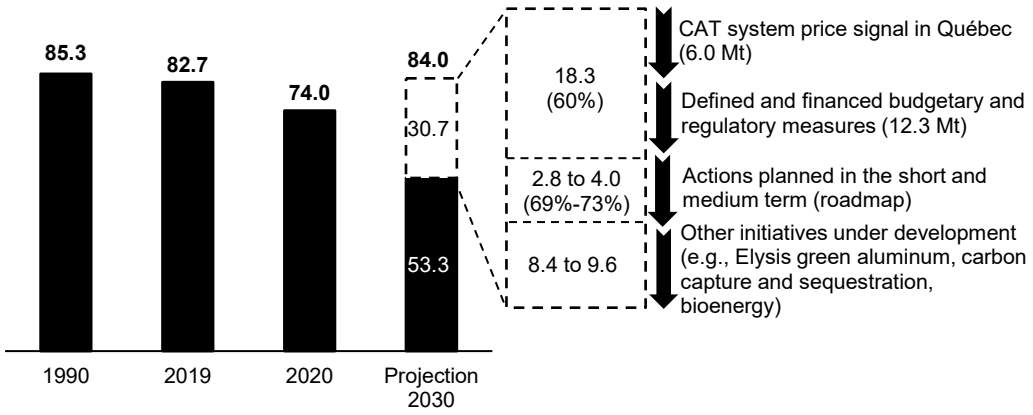
— budgetary and regulatory measures defined and financed notably in the *2023-2028 Implementation Plan* of the PGE (12.3 Mt).[3]

Moreover, other actions planned in the short and medium term (roadmap) would increase this proportion to reach between 69% and 73% of the necessary effort.

The remaining reductions could come from other annual enhancements of the PGE implementation plans and the initiatives of the federal government, the municipalities, the private sector, and the population overall.

CHART 5

Changes in GHG emissions and reductions necessary to attain the 2030 target
(millions of tonnes of CO_2 equivalent and as a percentage of the reductions required to achieve the target)



Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

[3] Appendix 5 indicates the initiatives included in the reference scenario.

1.3.1 Defined measures: 60% of the 2030 target

The initiatives defined until now could result in an estimated reduction of 18.3 Mt in GHG emissions in 2030, equivalent to 60% of the effort required to meet the reduction target.

❑ Transportation: 52% of the estimated reductions for 2030

Given the initiatives already defined in Québec to combat climate change, emissions in the transportation sector should reach 27.7 Mt in 2030, 9.5 Mt below the disengagement scenario (52% of the reductions of 18.3 Mt anticipated in 2030).

The anticipated reduction in GHG emissions in this sector is partly attributable to the CAT system price signal incentive but also to:

— the raising of the zero-emission vehicles (ZEV) standard to 2 million electric vehicles on Québec roads in 2030;

— the *Regulation respecting the integration of low-carbon-intensity fuel content into gasoline and diesel fuel,* which sets a 15% minimum share of renewable fuel for gasoline and 10% for diesel in 2030;

— the Écocamionnage program and the gradual electrification of the Québec government vehicle fleets, taxis, and school and urban buses.

❑ Industry: 28% of the estimated reductions for 2030

Emissions in the industrial sector should fall by 5.1 Mt in relation to the disengagement scenario (28% of the reductions of 18.3 Mt anticipated in 2030) to reach 21.2 Mt in 2030. Such reductions would stem primarily from:

— ongoing measures targeting the industrial sector, including Défi GES and the ÉcoPerformance program and a new section for large emitters under the Bioénergies program;

— regulations, in particular the regulation governing the increase in the share of renewable natural gas (RNG) in natural gas consumption to 10% in 2030 and the regulation governing halocarbons;

— free allocation rules targeting large industrial enterprises for the period 2024-2030 under the CAT system.

❑ Other sectors would account for 20% of the estimated reductions for 2030

In the other sectors, the defined measures should result in emissions reductions of 3.8 Mt in 2030 in relation to the disengagement scenario.

Indeed, the measures targeting residential, commercial, and institutional buildings sector should lead to a reduction of 2.3 Mt of GHG emissions in 2030. It is estimated that such a reduction would stem from:

— the ongoing ÉcoPerformance (section devoted to commercial and institutional buildings) and Chauffez vert programs and the implementation of a support measure to convert natural gas to electricity and dual energy;

— the regulation that prohibits the use of fuel oil for residential heating and the implementation of a reporting, rating, and energy performance system in existing commercial, institutional, and multi-residential buildings;

— the regulation governing broader use of RNG in natural gas consumption;

— the gradual electrification of the government's building inventory.

It is also estimated that the measures planned will lead to a reduction of 0.8 Mt in GHG emissions in the residual materials sector in 2030 in relation to their anticipated level in the disengagement scenario.

— This result is attributable mostly to the measures stemming from the *Organic Matter Development Strategy* and the implementation of composting and biomethanization projects.

Lastly, reductions of 0.7 Mt should be observed in the agriculture sector, through the enhanced management of nitrogenous fertilizers and the implementation of agricultural biomethanization projects.

TABLE 2

GHG emissions projection – Reference scenario
(millions of tonnes of CO_2 equivalent, unless otherwise indicated)

	Level				Anticipated reductions in 2030[1]	
	2019[2]	2020[2]	2025	2030	(Mt)	(%)
Transportation						
Light-duty vehicles	17.7	14.2	15.0	11.3	5.3	28.7
Heavy-duty vehicles	8.5	7.1	6.3	6.2	2.4	12.9
Other transportation[3]	10.3	10.4	10.2	10.2	1.9	10.2
Subtotal – Transportation	**36.5**	**31.6**	**31.5**	**27.7**	**9.5**	**51.8**
Industry						
Pulp and paper	1.5	1.3	1.2	0.7	0.9	5.1
Chemicals and refineries	3.4	3.0	3.0	2.6	1.1	6.2
Mines, pelletization, metallurgy, and aluminum	9.2	8.7	8.9	9.1	0.6	3.0
Cement and lime	3.9	3.4	3.8	3.9	0.3	1.6
Other industries[4]	7.4	6.5	6.0	4.9	2.1	11.7
Subtotal – Industry	**25.4**	**22.9**	**23.0**	**21.2**	**5.1**	**27.7**
Buildings	**8.3**	**7.1**	**6.0**	**5.6**	**2.3**	**12.6**
Residual materials	**4.6**	**4.5**	**4.5**	**3.9**	**0.8**	**4.1**
Agriculture	**7.9**	**7.9**	**7.7**	**7.2**	**0.7**	**3.7**
TOTAL	**82.7**	**74.0**	**72.6**	**65.7**	**18.3**	**100.0**

Note: Totals may not add due to rounding. The reductions stem from all the initiatives implemented to combat climate change, including the CAT system. It is assumed that the price of the CAT system emission allowances will reach $97 in 2030 in keeping with private-sector estimates.
(1) These are reductions in millions of tonnes in relation to the disengagement scenario in 2030 and the percentage breakdown of the reductions in relation to the total estimated reductions in the reference scenario. The emissions reductions that would have been achieved without government intervention (disengagement scenario) are thus not included in the reductions presented.
(2) Discrepancies can remain between the GHG emissions presented and the Québec inventory of greenhouse gas emissions because of the different data sources used.
(3) Other transportation includes off-road vehicles and rail, maritime, and air transportation.
(4) Other industries include the electricity, construction, forestry, non-ferrous metals (except aluminum) production and processing sectors, and other sectors such as electronics, glass, plastic, and rubber manufacturing.
Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

1.3.2 The CAT system: a reduction of 6 Mt of emissions in Québec in 2030

In 2013, Québec established the CAT system based on the principle of a market on which GHG emission allowances are traded.

— A limit is placed on the total GHG emissions of the sectors that the system covers, and prices change according to interaction between supply (the GHG emissions ceilings) and demand (GHG emissions).

It is estimated that the CAT system price signal will engender behavioural changes that promote GHG emission reductions of 6.0 Mt in Québec in 2030.

❑ Limiting emissions and achieving the desired reductions at the lowest cost

Carbon markets allow for the establishment of a maximum level of emissions in the sectors that the system covers while enabling households and businesses to choose the best means to do so.

Québec's CAT system has been linked to California's system since 2014, which pools the two governments' reduction targets and enables all businesses present on the market to exchange emission allowances regardless of their origin.

Accordingly, the carbon market engenders reductions in Québec but also in California. Such reductions are usually less costly, thereby limiting price increases in emission allowances.

— For example, according to ESMIA Consultants, nearly 60% of the reductions required to meet California's 2030 target could be achieved at less than $150 per tonne, compared with roughly 30% for Québec.

The reductions achieved in California but stemming from Québec's action reached 11.4 Mt in 2020. However, they should decrease gradually by 2030 because of the annual improvement of measures aimed at reducing GHG emissions in Québec.

❑ Carbon markets are gaining ground in North America

Other American states have recently followed Québec's and California's example by establishing carbon markets to achieve their reduction targets.

— Since January 1, 2023, Washington State manages a carbon market that covers 70% of its GHG emissions. It is engaged in consultations on possible linkages, including with Québec and California.

— New York State has announced that it will implement a carbon market in 2024.

— Oregon has also set up a market that covers the distributors of fossil fuels, which account for 45% of its GHG emissions.

These carbon markets are in addition to the Regional Greenhouse Gas Initiative (RGGI), implemented in 2009, which fixes the price for GHG emissions from electricity generation in 12 states in the northeastern United States.

❑ Optimization of the Québec-California carbon market

Since the CAT system's inception, the number of allowances available in the joint Québec-California market has increased, mainly because of significant emissions reductions, which have led to reduced demand for emission allowances.

In the coming year, Québec and California will jointly evaluate:[4]

— the best ways to optimize the carbon market to ensure coherence with the 2030 reduction target and the 2050 carbon neutrality target;

— the possibility of linking their system to other jurisdictions.

[4] On February 28, 2023, the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and the California Air Resources Board notified the participants in the carbon market that the market's operation could be adjusted during the coming year.

1.3.3 Measures planned in the short and medium term: a roadmap that would facilitate the attainment of between 69% and 73% of the target

According to the modelling conducted, the entire array of initiatives defined to combat climate change will lead to a reduction of 18.3 Mt in GHG emissions in 2030, equivalent to 60% of the effort required to achieve the target in Québec.

Other initiatives under preparation would increase this proportion in the coming years.

Indeed, additional reductions of 2.8 Mt to 4.0 Mt would be possible. By way of an example, they could take the form of:

- the optimization of the CAT system;
- more extensive use of zero-emission heavy-duty vehicles;
- improved industry performance in the realm of GHG emissions;
- more extensive recovery and conversion of thermal discharges;
- more extensive methane capture in landfill sites.

The establishment of this roadmap would facilitate the attainment of between 69% and 73% of the 2030 target in Québec.

To achieve the total targeted reductions in 2030, other initiatives will be examined in the coming years in the context of the annual updates of the PGE.

2. REDUCTION POTENTIALS

The reduction potentials illustrate, according to current knowledge, the least costly GHG emission reductions that would allow Québec to attain the 53.3 Mt target in 2030.[5]

- They result from a mathematical optimization and represent a simplification of reality intended to facilitate understanding of complex phenomena.

- Consequently, they reveal the best path to follow to achieve the reduction targets and facilitate the identification of decarbonization-related obstacles and constraints.

Such potentials constitute a theoretical representation of the mechanisms to which households, businesses and governments can resort to reduce their GHG emissions to a specific level. It can include:

- the adoption of innovative technologies such as electric vehicles and new, more efficient equipment, or the conversion of equipment to less emissive energy sources;

- behavioural changes and the adaptation of the economy to a new low-carbon reality.

Reduction potentials are a decision support tool. However, the government is also considering other factors in the decision-making process, such as:

- social acceptability, the carbon dioxide footprint, and the maturity of technologies;

- the impact on the most vulnerable populations and benefits for health, society, and the economy, e.g., climate change adaptation measures;

- the economic, legal, and political context in Québec and abroad.

The governments can subsequently establish initiatives to promote the attainment of such potentials.

- In the context of the updates of the PGE, such initiatives can, for example, take the form of reduced purchase prices for household technologies such as the Heating with Green Power program, investments in recharging infrastructure, or regulations such as the ZEV standard.

[5] The reduction potential scenario is a theoretical estimate subject to high variability. Indeed, despite recent technological advances, considerable uncertainty remains concerning their future development, especially as regards their accessibility. The reduction potentials presented in this section are updated regularly to reflect changes in the level of maturity of such technologies.

2.1 Progress in achieving the 2030 target

❑ The transportation sector: 56% of the reduction potential

In a scenario in which the 2030 target is achieved at the lowest cost in Québec, the transportation sector would account for 56% of the total reduction effort.

— This represents a reduction of 17.2 Mt in 2030 in relation to the disengagement scenario.

The reductions in this sector would stem from:

— the presence on Québec roads of 2 million electric vehicles;

— broader reliance on biofuels such as ethanol and bio-based diesel, which would account for 26% of fuel consumption in 2030;

— reduced automobile travel because of broader recourse to sustainable mobility.

❑ The industrial sector: 26% of the potential reductions

Potential in the industrial sector would represent an 8.0 Mt reduction in emissions in 2030, i.e., just over 26% of the total effort necessary in relation to the disengagement scenario. According to the estimates produced, this potential would stem from:

— energy efficiency gains;

— the use of RNG and bioenergy as well as the conversion to electricity of equipment;

— changes in manufacturing processes and reliance on disruptive technologies such as the gradual introduction of inert anodes in the aluminum sector;

— the use of carbon capture and sequestration technologies.

❑ Other sectors: 18% of the potential

The reduction potential of the buildings, residual materials, and agriculture sectors would represent 5.6 Mt, equivalent to 18% of the total effort necessary in Québec in 2030.

— The potential reduction for **buildings** would be in the order of 1.9 Mt because of energy efficiency gains and more extensive conversion to electricity of oil-fired and natural gas heating systems.

— The 2.0 Mt reduction potential in the **residual materials** sector in 2030 would stem from more extensive disposal of organic material from landfill sites through composting and biomethanization and the improvement of methane capture in landfill sites.

— The 1.7 Mt reduction potential in the **agriculture** sector in 2030 would result principally from the destruction or the recovery and conversion of methane from manure and improved agricultural practices.

TABLE 3

GHG emissions projection – Reduction potential scenario
(millions of tonnes of CO_2 equivalent, unless otherwise indicated)

	Level				Potential reductions in 2030[1]	
	2019[2]	**2020[2]**	**2025**	**2030**	**(Mt)**	**(%)**
Transportation	36.5	31.6	30.0	20.0	17.2	56.1
Industry[3]	25.4	22.9	22.6	18.3	8.0	26.1
Buildings	8.3	7.1	6.7	6.0	1.9	6.0
Residual materials	4.6	4.5	4.0	2.7	2.0	6.4
Agriculture	7.9	7.9	6.7	6.3	1.7	5.4
TOTAL	**82.7**	**74.0**	**70.0**	**53.3**	**30.7**	**100.0**

Note: Totals may not add due to rounding.
(1) These are reductions in millions of tonnes in relation to the disengagement scenario in 2030 and the percentage breakdown of the potential reductions in relation to the total estimated reductions. The emissions reductions that would have been achieved without government intervention (disengagement scenario) are thus not included in the reductions presented.
(2) Discrepancies can remain between the GHG emissions presented and the Québec inventory of greenhouse gas emissions because of the different data sources used.
(3) This sector includes emissions related to electricity generation and distribution.
Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

❑ A gradual approach to better harness technological development

The Québec government is gradually improving its approach in the context of the annual update of the PGE implementation plans.

Indeed, the initiatives defined to reduce GHG emissions are established in a context of uncertainty surrounding future technological changes and economic conditions.

Until now, most of the defined initiatives rely on technologies whose costs to society by the year 2030 are estimated at less than $300/tonne. Such costs include:

— all public and private investments and operating expenses to adopt technologies and use them for their useful life;

— other costs (such as increased electricity supply) and benefits (such as behavioural change, reduced running costs, and the improved efficiency of production processes).

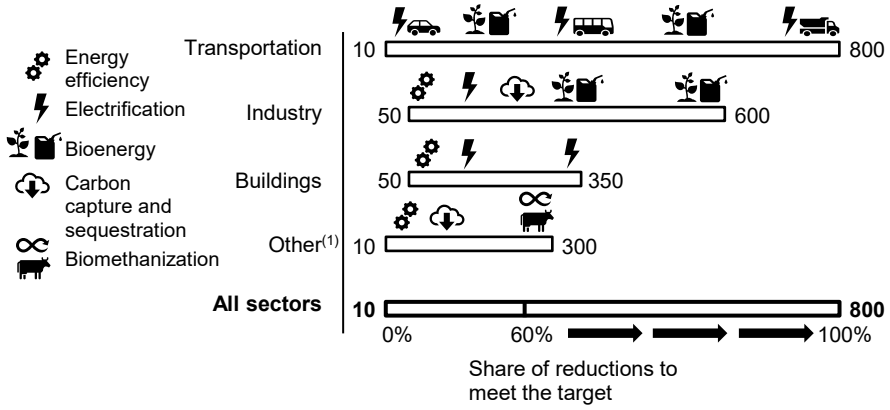
However, the impending stages in the realm of GHG emission reduction will require the adoption of higher-cost technologies.

— Indeed, it is estimated that the attainment in Québec of the 2030 target will require technologies whose cost could reach up to $800/tonne by 2030.

The gradual improvement of the initiatives to combat climate change thus facilitates the evaluation of the best ways to effectively reduce GHG emissions in the long term, achieve all the reductions necessary to meet the 2030 target, and adjust the defined initiatives considering technological development and the context.

ILLUSTRATION 1

GHG emission reduction costs and examples of technologies for the year 2030
(in 2021 dollars per tonne of CO_2 equivalent reduced, unless otherwise indicated)



Note: Reduction costs are presented in relation to the disengagement scenario for the year 2030.
(1) Includes the residual materials and agriculture sectors.
Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

2.2 An approach aligned with reduction potentials

In the context of the PGE implementation plans, the Québec government has adopted a gradual approach that allows for the realisation of 60% of the reductions necessary to meet the 2030 target in keeping with the evaluation of reduction potentials.

Indeed, it is estimated that the entire array of initiatives defined in Québec to combat climate change will generate reductions in the sectors with the most significant technological potentials:

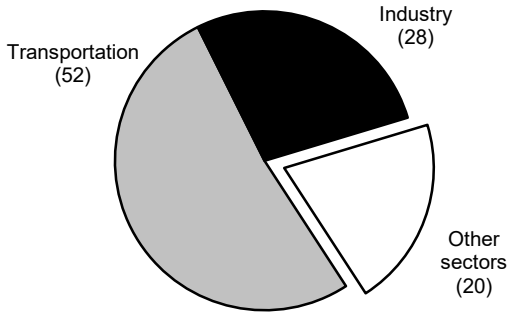
— the transportation sector, which accounts for 52% of the anticipated reductions in the reference scenario, while the reduction potentials in this sector represent 56% of the total;

— the industrial sector, which accounts for 28% of the estimated reductions, compared with 26% in the reduction potential scenario.

This approach maximizes the impact of measures to tackle climate change on GHG emission reduction in Québec, bearing in mind decarbonization-related obstacles and other factors.

CHART 6

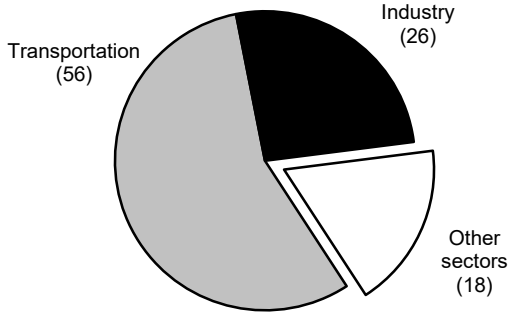
Breakdown of the reductions in the reference scenario
(as a percentage in relation to the disengagement scenario)



Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

CHART 7

Breakdown of the reductions in the reduction potential scenario
(as a percentage in relation to the disengagement scenario)



Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

3. GHG EMISSION REDUCTIONS THAT WILL BENEFIT THE QUÉBEC ECONOMY

The *2023-2028 Implementation Plan* provides for $9 billion in investments that will enable Québec to advantageously position itself in a low-carbon future world.

In addition to reducing Québec's GHG emissions, the defined initiatives will have an overall positive impact on the economy. This impact stems from two separate mechanisms.

- The CAT system engenders a price signal on carbon, which reduces real GDP but also hydrocarbon imports.
- Revenues from the CAT system are reinvested in the Québec economy through the measures stipulated in the PGE implementation plans, which fosters long-term economic growth.

Accordingly, it is estimated that the CAT system and the entire array of initiatives defined in Québec to combat climate change will have a beneficial impact of $2 billion on Québec's real GDP in 2030. This impact would stem from:

- additional investments totalling $1.6 billion, in particular because of the PGE implementation plans and purchases by businesses of emission-reducing technologies;
- an increase in consumption of $0.5 billion attributable to the positive impact on the Québec economy of the investments carried out in the context of the PGE;
- a net decrease of $0.1 billion in exports.
  - This drop would stem principally from increased imports accompanying the anticipated rise in consumption and investments, mainly because of the implementation of the PGE.
  - What is more, the long-term impact on net exports should be positive when investments related to GHG emission reduction have been made and hydrocarbon imports are lower.

TABLE 4

Economic impact in 2030 of the investments made in the context of the implementation plans of the *2030 Plan for a Green Economy*
(billions of 2021 dollars)

	Measures under the PGE	CAT system price signal	Total
Consumption	1.4	−0.9	**0.5**
Investment	2.2	−0.6	**1.6**
Net exports	−0.0	−0.1	**−0.1**
Government spending	—	—	**—**
TOTAL – GDP	**3.6**	**−1.6**	**2.0**
Household disposable income	*1.8*	*−1.2*	***0.6***

Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

❑ The PGE is contributing to improving the economy's productive capacity

The investments made under the PGE will enable businesses to bolster their productivity by replacing their equipment with more efficient systems and by relying on renewable energy sources such as electricity and bioenergy.

Accordingly, it is estimated that the entire array of initiatives defined to combat climate change will increase Québec's long-term annual productive capacity by $3 billion.

Furthermore, energy productivity, i.e., the level of economic strength created per unit of energy, should rise in the coming years.

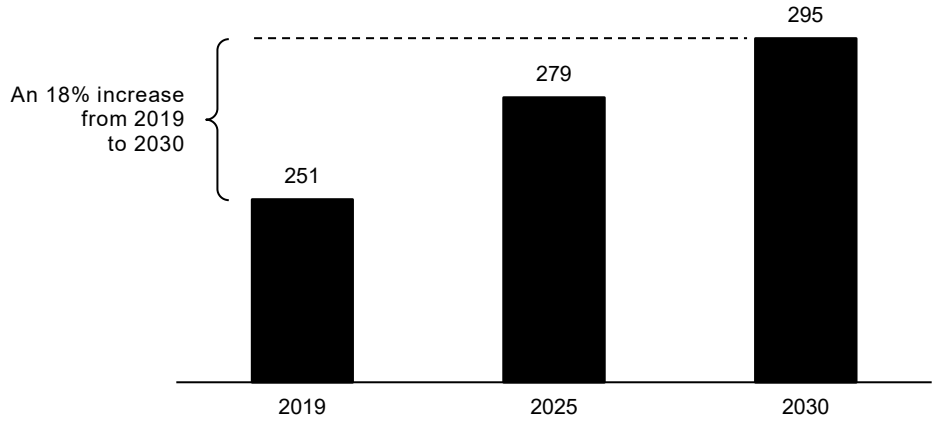
— Indeed, it is estimated that Québec produced $251 per gigajoule of energy consumed in 2019, compared with the Canadian average of $243.

— This level should rise gradually in the coming years to reach $295 per gigajoule in 2030.

This improvement will stem from the combined impact of the PGE on growing business productivity and reduced reliance on fossil fuels.

CHART 8

Energy productivity in Québec
(in dollars per gigajoule)



Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

4. CONCLUSION

The Québec government wants to reach the GHG emission reduction target of 37.5% in 2030 in relation to the 1990 level by maximizing the reductions achieved in its territory.

The initiatives defined until now to combat climate change will make it possible to achieve 60% of this target.

— This represents an increase in relation to the proportion of 51% presented in the *2022-2027 Implementation Plan* of the PGE.

— The initiatives will be further enhanced in the coming years in the context of the annual update of the PGE implementation plans to achieve all the necessary reductions by 2030.

The Québec government is a leader in the realm of tackling climate change and is committed to reducing GHG emissions.

— It will continue to affirm its leadership and display exemplariness by reducing its carbon dioxide footprint.

Growing efforts must be made in the coming years to meet Québec's targets.

Québec's decarbonization can only be achieved with the full participation of society.

— Indeed, it is households, businesses, and municipalities, through their individual and collective choices, that will make Québec's transformation possible.

APPENDIX 1: MODELS USED TO PRODUCE THE IMPACT ANALYSES

The Ministère des Finances du Québec and the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs rely on a combination of models to estimate changes in GHG emissions, reduction potentials, and the economic impacts of the fight against climate change.

- The general equilibrium model of the Ministère des Finances du Québec for the environment (MEGFQ-E) provides a macroeconomic perspective of the fight against climate change and considers the impact of the CAT system and the investments made on the economy and Québec's GHG emissions.

- The energy system for Québec, the environment, climate, and electricity model (SEQUENCE) provides a technical perspective of the various technological and energy choices that can be made to reduce GHG emissions.

The models are used jointly to thoroughly study the interrelationships between the economy and the fight against climate change.

Lastly, a simulation model based on the Low Emissions Analysis Platform (LEAP) is also used in the simulations conducted.

❑ The MEGFQ-E provides a macroeconomic perspective of the fight against climate change

The MEGFQ-E represents the key interrelationships in Québec's economy through an elaborate system of equations.

- The model details the entire structure of the economy and the CAT system and therefore takes into account interactions between economic agents (households, businesses, and governments) as well as feedback effects between markets.

- Prices and quantities adjust to balance all markets simultaneously, in particular the labour and goods and services markets. Households and businesses adjust their habits to changes in the economy.

❑ The SEQUENCE model considers technologies and their long-term costs

The SEQUENCE model is a highly detailed energy optimization tool that projects long-term GHG emissions and measures technological reduction potentials to meet the 2030 target.

- It considers anticipated technological change, efficiency in manufacturing processes, the anticipated level of economic activity in different sectors, and the prices of different forms of energy.

The model is based on The Integrated MARKAL-EFOM System (TIMES), sponsored by the International Energy Agency.

❑ A combination of models to capture the interplay between the economy and GHG emission reduction

The link between the SEQUENCE model and the MEGFQ-E allows the tools to communicate to better capture the interplay between the economy and GHG emissions.

This methodology enables the Québec government to conduct thorough, complete analyses of scenarios to combat climate change by simultaneously providing economic, climatic, and energy-related perspectives.

The exercise, conducted between a TIMES type model and a calculable general equilibrium model, represents a methodological innovation that has few equivalents worldwide.

❑ The key sources of data that sustain the models

The models are updated annually considering information such as:

— the economic and financial forecasts produced by the Ministère des Finances du Québec;

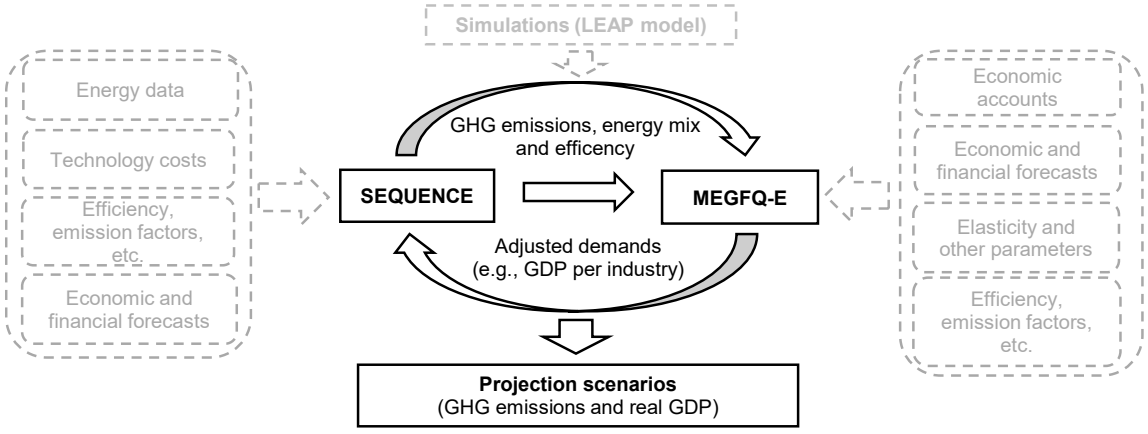
— the Québec inventory of greenhouse gas emissions and the mandatory reporting of businesses concerning contaminants in the atmosphere;

— the scientific literature pertaining to innovative technologies and their costs;

— other information sources such as Statistics Canada, Environment and Climate Change Canada, Natural Resources Canada, and the Société de l'assurance automobile du Québec.

ILLUSTRATION 2

Representation of the models used



Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

APPENDIX 2: KEY RISKS THAT CAN AFFECT ACTUAL EMISSION TRENDS

The models used to produce the GHG emission project scenarios and the economic impact analyses hinge on several assumptions, which are associated with risks that could influence actual GHG emission trends and the economy.

❑ A different trend in economic growth

The simulations are based on the Québec government's most recent economic and financial projections for the sectors of the economy as of March 10, 2023.

A different trend in economic growth or financial variables in the coming years could affect the economic impacts and the GHG emission reductions stemming from the initiatives defined to combat climate change.

❑ A different trend in prices

The simulations are based on a GHG emission allowance price scenario on the carbon market in keeping with the projections produced by the private sector.

However, the price trend will depend on technological innovations, the possible addition of new partners to the carbon market, and the measures adopted by the participating governments.

— Indeed, the pace of the development and adoption of new GHG emission reduction technologies will affect the cost of meeting the targets.

— What is more, the addition of new partners to the carbon market could affect the price depending on how readily they can reduce their GHG emissions to meet their climate targets.

Accordingly, a higher (lower) price would amplify (mitigate) the impacts of measures to tackle climate change in Québec.

Following the example of the price of emission allowances in the context of the carbon market, the projections presented in this document also hinge on assumptions concerning trends in other prices in the economy by the year 2030.

Changes in these prices will depend on the relationship between supply and demand on each market. Accordingly, it could be affected by:

— the current labour shortage, which is putting pressure on wages;

— excess demand or limited supply of raw materials;

— ongoing disruptions in supply chains;

— the global geopolitical context, including Russia's ongoing invasion of Ukraine.

❑ Updates of statistical data

The analyses hinge on the best statistical data available at the time the projection scenarios were produced.

The historic data used to estimate the GHG emissions are based on information from statistics agencies and other organizations.

— An elevated level of uncertainty surrounds such information despite significant advances in the accuracy of the data published in recent years.

— Accordingly, the data are revised frequently, which can affect the estimates produced.

Moreover, data pertaining to technologies and their costs come from various sources of information such as specialized agencies and scientific articles.

— Knowledge respecting future technologies is changing very quickly, which demands the regular adjustment of GHG emissions projections and the evaluation of the anticipated reductions.

❑ Technological breakthroughs

The GHG emissions projections and the economic impacts presented hinge on assumptions concerning technological advances by the year 2030.

For example, in the reference scenario, the adoption of less emissive technologies occurs when they become economically advantageous considering the decreasing cost of the technologies, higher carbon pricing, and the financial support that the government offers.

However, a high degree of uncertainty can be linked to them.

— Accordingly, innovative technologies could emerge and engender more pronounced emission reductions by 2030.

— Conversely, delays in the development of certain technologies could engender lower-than-anticipated emission reductions.

Furthermore, in the models, electricity generation is adjusted to optimize the entire array of technological choices in the economy, according to their cost.

— However, a lower level of electricity generation in Québec could also impact the scenarios carried out.

❑ Public and business support for the fight against climate change

The models used hinge on assumptions respecting the structure of the economy and the behaviour of households and businesses.

The fight against climate change requires all economic sectors and the public to contribute.

Accordingly, support to a greater or lesser degree for the fight against climate change from households and businesses could affect emission levels.

❑ The external environment

Changes in the external environment can significantly impact GHG emissions and economic spin-off in Québec.

For example, the adoption of policies to combat climate change in several regions could promote:

— broader global supply and demand for lower-carbon products, which could affect the price of such products on international markets;

— the accelerated development of certain technologies, which could increase their availability and adoption.

Moreover, high global carbon pricing or the adoption of carbon adjustment mechanisms at the border would impact the economy and the level of GHG emissions.

❑ The full use of budgets allocated to the fight against climate change

The projections presented hinge on the assumption that all the budgets earmarked for combating climate change are used.

— GHG emissions could thus be higher if the full potential of certain programs implemented is not achieved.

What is more, some degree of uncertainty persists concerning the measures that the federal government and the municipalities will implement to fight climate change.

APPENDIX 3: ADDITIONAL INFORMATION

TABLE 5

GHG emissions projection – Disengagement scenario
(millions of tonnes of CO_2 equivalent, unless otherwise indicated)

	Level					Change
	1990[1]	**2019[1]**	**2020[1]**	**2025**	**2030**	**2019-2030**
Transportation						
Light-duty vehicles	14.5	17.7	14.2	16.7	16.6	−1.1
Heavy-duty vehicles	3.6	8.5	7.1	8.5	8.5	0.0
Other transportation[2]	9.1	10.3	10.4	11.1	12.1	1.8
Subtotal – Transportation	**27.2**	**36.5**	**31.6**	**36.3**	**37.2**	**0.7**
Industry						
Pulp and paper	4.5	1.5	1.3	1.6	1.6	0.1
Chemicals and refineries	5.0	3.4	3.0	3.7	3.8	0.4
Mines, pelletization, metallurgy, and aluminum	12.4	9.2	8.7	9.7	9.7	0.5
Cement and lime	2.7	3.9	3.4	4.1	4.2	0.3
Other industries[3]	8.8	7.4	6.5	6.9	7.0	−0.4
Subtotal – Industry	**33.5**	**25.4**	**22.9**	**25.9**	**26.3**	**0.9**
Buildings						
Residential	7.0	3.5	3.0	2.9	2.8	−0.7
Commercial and institutional	4.3	4.8	4.1	5.0	5.1	0.3
Subtotal – Buildings	**11.2**	**8.3**	**7.1**	**7.9**	**7.9**	**−0.4**
Residual materials						
Burying of residual materials	5.7	4.0	3.8	4.2	4.2	0.2
Other[4]	0.5	0.6	0.7	0.5	0.5	−0.1
Subtotal – Residual materials	**6.2**	**4.6**	**4.5**	**4.7**	**4.7**	**0.1**
Agriculture						
Enteric fermentation	3.3	2.9	2.9	2.8	2.8	−0.1
Manure management	1.5	2.1	2.1	2.1	2.1	0.0
Management of agricultural soils, liming, urea, and other fertilizers	2.3	2.9	3.0	3.0	3.0	0.1
Subtotal – Agriculture	**7.1**	**7.9**	**7.9**	**7.9**	**7.9**	**−0.0**
TOTAL	**85.3**	**82.7**	**74.0**	**82.7**	**84.0**	**1.3**

Note: Totals may not add due to rounding. The disengagement scenario illustrates potential changes in GHG emissions without government intervention starting in 2021. It considers economic growth and underlying technological improvements.
(1) Discrepancies can remain between the GHG emissions presented and the Québec inventory of greenhouse gas emissions because of the different data sources used.
(2) Other transportation includes off-road vehicles and rail, maritime, and air transportation.
(3) Other industries include the electricity, construction, forestry, non-ferrous metals (except aluminum) production and processing sectors, and other sectors such as electronics, glass, plastic, and rubber manufacturing.
(4) The “Other” category includes the biological treatment and incineration of residual materials and wastewater treatment.
Sources: Ministère de l’Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

TABLE 6

GHG emissions projection – Reference scenario

(millions of tonnes of CO_2 equivalent, unless otherwise indicated)

	Level				Anticipated reductions in 2030[1]	
	2019[2]	2020[2]	2025	2030	(Mt)	(%)
Transportation						
Light-duty vehicles	17.7	14.2	15.0	11.3	5.3	28.7
Heavy-duty vehicles	8.5	7.1	6.3	6.2	2.4	12.9
Other transportation[3]	10.3	10.4	10.2	10.2	1.9	10.2
Subtotal – Transportation	**36.5**	**31.6**	**31.5**	**27.7**	**9.5**	**51.8**
Industry						
Pulp and paper	1.5	1.3	1.2	0.7	0.9	5.1
Chemicals and refineries	3.4	3.0	3.0	2.6	1.1	6.2
Mines, pelletization, metallurgy, and aluminum	9.2	8.7	8.9	9.1	0.6	3.0
Cement and lime	3.9	3.4	3.8	3.9	0.3	1.6
Other industries[4]	7.4	6.5	6.0	4.9	2.1	11.7
Subtotal – Industry	**25.4**	**22.9**	**23.0**	**21.2**	**5.1**	**27.7**
Buildings						
Residential	3.5	3.0	2.3	2.1	0.8	4.2
Commercial and institutional	4.8	4.1	3.7	3.5	1.5	8.4
Subtotal – Buildings	**8.3**	**7.1**	**6.0**	**5.6**	**2.3**	**12.6**
Residual materials						
Burying of residual materials	4.0	3.8	4.1	3.5	0.7	3.8
Other[5]	0.6	0.7	0.5	0.4	0.1	0.3
Subtotal – Residual materials	**4.6**	**4.5**	**4.5**	**3.9**	**0.8**	**4.1**
Agriculture						
Enteric fermentation	2.9	2.9	2.8	2.8	0.0	0.1
Manure management	2.1	2.1	1.9	1.6	0.5	2.5
Management of agricultural soils, liming, urea, and other fertilizers	2.9	3.0	2.9	2.8	0.2	1.2
Subtotal – Agriculture	**7.9**	**7.9**	**7.7**	**7.2**	**0.7**	**3.7**
TOTAL	**82.7**	**74.0**	**72.6**	**65.7**	**18.3**	**100.0**

Note: Totals may not add due to rounding. The reductions stem from all the initiatives implemented to combat climate change, including the CAT system. It is assumed that the price of the CAT system emission allowances will reach $97 in 2030 in keeping with private-sector estimates.

(1) These are reductions in millions of tonnes in relation to the disengagement scenario in 2030 and the percentage breakdown of the reductions in relation to the total estimated reductions in the reference scenario. The emission reductions that would have been achieved without government intervention (disengagement scenario) are thus not included in the reductions presented.

(2) Discrepancies can remain between the GHG emissions presented and the Québec inventory of greenhouse gas emissions because of the different data sources used.

(3) Other transportation includes off-road vehicles and rail, maritime, and air transportation.

(4) Other industries include the electricity, construction, forestry, non-ferrous metals (except aluminum) production and processing sectors, and other sectors such as electronics, glass, plastic, and rubber manufacturing.

(5) The “Other” category includes the biological treatment and incineration of residual materials and wastewater treatment.

Sources: Ministère de l’Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

TABLE 7

GHG emissions projection – Reduction potential scenario

(millions of tonnes of CO_2 equivalent, unless otherwise indicated)

	Level				Potential reductions in 2030[1]	
	2019[2]	2020[2]	2025	2030	(Mt)	(%)
Transportation						
Light-duty vehicles	17.7	14.2	14.6	10.0	6.5	21.3
Heavy-duty vehicles	8.5	7.1	6.1	3.6	5.0	16.2
Other transportation[3]	10.3	10.4	9.3	6.4	5.7	18.6
Subtotal – Transportation	**36.5**	**31.6**	**30.0**	**20.0**	**17.2**	**56.1**
Industry						
Pulp and paper	1.5	1.3	1.3	0.7	0.9	2.8
Chemicals and refineries	3.4	3.0	3.1	2.7	1.1	3.5
Mines, pelletization, metallurgy, and aluminum	9.2	8.7	9.3	7.4	2.3	7.4
Cement and lime	3.9	3.4	3.6	2.6	1.6	5.2
Other industries[4]	7.4	6.5	5.4	4.8	2.2	7.2
Subtotal – Industry	**25.4**	**22.9**	**22.6**	**18.3**	**8.0**	**26.1**
Buildings						
Residential	3.5	3.0	2.5	2.2	0.6	2.1
Commercial and institutional	4.8	4.1	4.2	3.9	1.2	4.0
Subtotal – Buildings	**8.3**	**7.1**	**6.7**	**6.0**	**1.9**	**6.0**
Residual materials						
Burying of residual materials	4.0	3.8	3.6	2.3	1.9	6.1
Other[5]	0.6	0.7	0.4	0.4	0.1	0.3
Subtotal – Residual materials	**4.6**	**4.5**	**4.0**	**2.7**	**2.0**	**6.4**
Agriculture						
Enteric fermentation	2.9	2.9	2.5	2.4	0.4	1.2
Manure management	2.1	2.1	1.8	1.5	0.6	1.9
Management of agricultural soils, liming, urea, and other fertilizers	2.9	3.0	2.4	2.3	0.7	2.3
Subtotal – Agriculture	**7.9**	**7.9**	**6.7**	**6.3**	**1.7**	**5.4**
TOTAL	**82.7**	**74.0**	**70.0**	**53.3**	**30.7**	**100.0**

(1) Totals may not add due to rounding. These are reductions in millions of tonnes in relation to the disengagement scenario in 2030 and the percentage breakdown of the reductions in relation to the total estimated reductions. The emission reductions that would have been achieved without government intervention (disengagement scenario) are thus not included in the reductions presented.
(2) Discrepancies can remain between the GHG emissions presented and the Québec inventory of greenhouse gas emissions because of the different data sources used.
(3) Other transportation includes off-road vehicles and rail, maritime, and air transportation.
(4) Other industries include the electricity, construction, forestry, non-ferrous metals (except aluminum) production and processing sectors, and other sectors such as electronics, glass, plastic, and rubber manufacturing.
(5) The “Other” category includes the biological treatment and incineration of residual materials and wastewater treatment.
Sources: Ministère de l’Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.

APPENDIX 4: SENSITIVITY ANALYSIS

The GHG emissions projections are based on various economic, financial, and technological assumptions, which must be updated periodically to reflect changes in the economic situation and scientific knowledge.

— Such revisions directly affect the GHG emissions projections, and the assessment of the reductions achieved.

Analyses have, therefore, been conducted to ascertain the sensitivity of the outcomes to a variation in certain assumptions.

❑ The reference scenario

It is estimated that all the initiatives planned in Québec to combat climate change will lead to a reduction of 18.3 Mt in GHG emissions in 2030, which corresponds to a GHG emissions level of 65.7 Mt in 2030 (reference scenario).

Such estimates hinge on a set of assumptions, including:

— that the price of the CAT system emission allowances will reach $97 per tonne in 2030, which is in keeping with private-sector forecasts;

— a gradual decrease in the cost of technologies;

— economic growth consistent with the forecasts in Budget 2023-2024.

■ How to achieve lower GHG emissions levels

In relation to the reference scenario, projected GHG emissions could fall more rapidly to 59.9 Mt in 2030 if, for example:

— the cost of GHG emission reduction technologies were 10% lower on average in 2030;

— demand for road transport and in the agriculture sector was 10% lower in 2030 in the wake of behavioural change;

— the energy efficiency of building heating was 10% higher;

— the price of CAT system emission allowances rose faster to reach its ceiling in 2030 ($165 per tonne), thereby more significantly changing consumption habits and production methods.

How to engender higher GHG emissions levels

In relation to the reference scenario, the projected GHG emissions could fall less rapidly to 71.3 Mt in 2030 if, for example:

— the cost of GHG emission reduction technologies were 10% higher on average in 2030;

— demand for road transport and in the agriculture sector was 10% higher in 2030 in the wake of behavioural change;

— the energy efficiency of building heating was 10% lower;

— the price of CAT system emission allowances rose more slowly to reach its minimum level in 2030 ($45 per tonne), thereby engendering less significant changes in consumption habits and production methods.

APPENDIX 5: THE INITIATIVES MODELLED IN THE REFERENCE SCENARIO

TABLE 8

Main initiatives modelled in the reference scenario

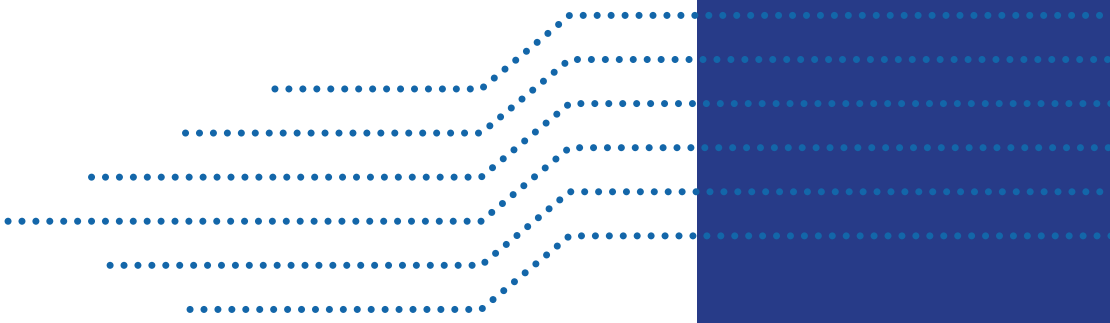
Global	– GHG emission cap-and-trade system (CAT system)
	– Municipal climate plans (Montréal, Québec city, Accélérer la transition climatique locale program)
Transportation	**Program**
	– Roulez vert
	– Transportez vert
	– Écocamionnage
	– Government assistance program to improve the efficiency of maritime, air, and rail transports (PETMAF)
	Regulations
	– Increasing to 2 million vehicles in 2030 the zero-emission vehicles standard and prohibition in 2035 on the sale of gasoline-powered vehicles
	– *Regulation* respecting *the integration of low-carbon-intensity fuel content into gasoline and diesel fuel*
	– *Clean Fuel Regulations* (federal government)
	Other initiatives
	– Electrification by 2030 of 65% of the school bus fleet and 55% of urban buses
	– Electrification of the government car fleet
	– Programme d'aide au développement du transport collectif
Industry	**Program**
	– ÉcoPerformance
	– ÉcoPerformance grands émetteurs
	– Bioénergies
	– Bioénergies grands émetteurs
	– Défi GES
	– The Québec industrial sector decarbonization assistance measure (MADI)
	– The *Québec Green Hydrogen and Bioenergy Strategy*
	– The Net Zero Accelerator Initiative (federal government)
	– The *Hydrogen Strategy for Canada* (federal government)
	Regulations
	– Regulation *concerning* the minimum volume of renewable natural gas in natural gas supplies in Québec (10% in 2030)
	– *Regulation respecting halocarbons*
	– The 2024-2030 free allowance rules for large industrial enterprises under the CAT system, including the *consignment* of emission allowance units
	Other initiatives
	– Renewable energy supply of 80% for Hydro-Québec's off-grid systems by 2030

TABLE 8

Main initiatives modelled in the reference scenario (continued)

Buildings	**Program**
	– Chauffez vert
	– ÉcoPerformance (commercial and institutional sections)
	– Waste heat recovery
	– Net zero building code initiative (federal government)
	Regulations
	– *Regulation respecting oil-fired heating appliances*
	– Energy reporting, rating and performance system
	Other initiatives
	– 60% reduction in GHG emissions from the government building inventory in 2030 in relation to 1990
	– Support to convert from natural gas to electricity and dual energy to manage peak demand
Other	**Agriculture**
	– *Plan d'agriculture durable*
	– Develop, make operational, and broaden the use of practices and technologies that reduce methane emissions from cattle breeding operations
	Residual materials
	– *Organic Matter Development Strategy*
	– Programme de traitement des matières organiques par biométhanisation et compostage (PTMOBC)
	– Draft regulation on landfill gas (federal government)

Sources: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and Ministère des Finances du Québec.



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