2016-2025
Québec Energy Policy

FOSSIL HYDROCARBONS

Québec

Ministère de l'Énergie et des Ressources naturelles
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TABLE OF CONTENTS

FIGURES

TABLES

TEXT BOXES

STEPS IN THE PROCESS

In 2006, the government adopted the *Québec Energy Strategy 2006-2015: Using Energy to Build the Québec of Tomorrow,* which hinged primarily on the revival and acceleration of the development of Québec's hydroelectric potential, the establishment of a wind power option, the diversification of sources of supply of natural gas and oil, and the promotion of greater energy efficiency.

The time has come to review the Québec government's energy-related priorities and orientations. To this end, it is necessary to examine the needs and expectations in respect of the different energy options that are underpinning Québec society's economic vitality and development. At the same time, this marks an opportunity to reassess the relevance, performance and efficiency of the tools that Québec has adopted to ensure the sound governance, development and responsible use of energy resources.

BACKGROUND DOCUMENTS

The series of background documents that the Ministère de l'Énergie et des Ressources naturelles is making available is intended to sustain reflection that will clarify the situation and challenges specific to contemporary Québec. The background documents seek to delineate the focus of reflection in light of success achieved at home and abroad and to raise questions that enable us to make enlightened choices over the coming decade.

This document assembles information and data that present an overall profile of the oil and natural gas options in Québec. It also briefly presents a status report and examines concerns, in particular as regards environmental protection, that the possible development of a hydrocarbon production industry in Québec raises.

Québec is changing. It must reposition itself bearing in mind its energy consumption profile, the global and continental context and the values that Quebecers cherish from the standpoint of economic development, environmental protection and social justice.

DESCRIPTION OF THE CONSULTATION PROCESS

The Québec government will adopt by the end of 2015 an energy policy covering the period 2016 to 2025. The policy will define the orientations that will enable Québec to:

- participate in a rapidly changing worldwide energy and economic context;
- maintain and, indeed, broaden its leadership in the realm of renewable energies;
- enhance its performance in the realms of energy efficiency, behavioural progress and education pertaining to energy and technological innovation;
- pursue the transition to a low-carbon economy and greater energy self-sufficiency;
- make energy resources a lever of wealth creation and social development in all regions.

The policy will stem from a mobilization and consultation approach that calls upon Quebecers and stakeholders in Québec society focusing on:

- energy efficiency and innovation;
- renewable energies;
- the decarbonization of road transport;
- hydrocarbons.

In the fall of 2013, the Commission on Energy Issues in Québec visited Québec's regions to ascertain the concerns and collect the reflections of individuals and organizations interested in the environmental, economic and social issues related to energy. A report containing 57 recommendations was drawn from the 460 briefs, 300 presentations, 250 contributions on the Internet or in person during the 47 public consultation meetings, three workshops with the Aboriginal communities and numerous meetings between the commissioners and experts from the universities or public bodies.

As announced on November 7, 2014, the process will continue. First, the Ministère de l'Énergie et des Ressources naturelles will invite a group of experts from Québec and abroad to sit on each of the expert panels. The experts invited will meet to discuss their perspective of Québec's energy future.

At the same time as the experts are deliberating, the public will be invited to comment online on the observations, challenges and questions submitted to the experts. Meetings open to individuals and organizations wishing to express their viewpoints to the representatives of the Ministère de l'Énergie et des Ressources naturelles will be organized for each theme. Aboriginal representatives will also be invited to share the viewpoints of their communities.

On the strength of the outcome of the extensive reflection and debate, the government will make public in the fall of 2015 its 2016-2025 energy policy.

INTRODUCTION

Fossil hydrocarbons play a pivotal role in Québec's economy and still satisfy 53% of its energy needs. Oil and natural gas are entirely imported from producing provinces and states, which has a significant impact on Québec's trade balance.

The quantities of hydrocarbons in question are striking. In the case of oil, Québec consumes the equivalent of 289 000 barrels per day of refined products and the amounts of crude oil that the two refineries operating in Québec receive are even greater still. These flammable materials travel on the St. Lawrence Seaway, in oil pipelines, by rail and by road for delivery to industrial, commercial, institutional and residential users everywhere, in all regions, including in the territory that the Northern Plan covers, in particular in isolated communities that rely on such products to generate electricity.

While annual consumption of natural gas is lower than that of petroleum products, it stands at 6 billion m^3 and satisfies 14% of Québec's total energy demand. Natural gas is mainly distributed by means of a distribution network that serves some 230 000 customers.

Technological innovation has allowed in recent years the development of resources that were hitherto deemed to be economically unexploitable. This new situation has revived interest in exploration for geological formations that may contain hydrocarbons throughout North America and in the world. The acquisition of geoscientific knowledge and exploration work have revealed the presence of hydrocarbons and the plausible nature of the implementation of a production option in Québec.

However, the popularity of hydrocarbons to support industrialization and economic growth has given rise to the problem of climate change that is threatening the equilibrium of the planet's biological and geoclimatic systems.

This document presents the dynamic underlying the consumption, transportation, supply and production of oil and natural gas in Québec. It summarizes the challenges stemming from the two energy options and proposes a series of question to sustain reflection on the orientations that the new Québec energy policy must promote in the coming decade.

SECTION 1

BASIC CONCEPTS

Hydrocarbons are organic compounds made up exclusively of carbon and hydrogen atoms. Hydrocarbon also refers, in particular, to oil and natural gas, which are fossil resources since they are derived from the transformation of the organic matter trapped in sedimentary rock that has settled then been subjected to specific temperatures and pressure for millions of years. The geological features required to form hydrocarbons explain the relative scarcity of the resources available and their non-renewable nature in terms of human needs.

The "conventional" or "unconventional" nature of deposits does not distinguish the oil or natural gas formation process but the composition of the rock in which they are found and, consequently, the techniques employed for their extraction.

In the case of conventional resources, the hydrocarbons formed in the source rock migrate toward porous, permeable rock, called the reservoir, which is covered with cap rock that "traps" the hydrocarbons in the reservoir and prevents them from rising to the surface where they would deteriorate. There, they form deposits that are extracted by simple vertical drilling, since the reservoir rock's natural porosity allows the hydrocarbons to migrate toward the well.

As for unconventional oil, the hydrocarbons remain trapped in the barely porous, permeable strata of the sedimentary basin. They can even be trapped in the source rock where they are formed (bituminous shales, shale gas and oil). In other cases, such as oil sands and heavy oils, the physical features of the oil itself, which is very viscous, indeed, almost solid, do not allow for conventional extraction. Unconventional oil extraction techniques are more complex since they rely on advanced technologies, in particular hydraulic fracturing and vapour extraction.[1]

1 Connaissances des énergies. *Formation du pétrole* [connaissancedesenergies.org/fiche-pedagogique/formation-du-petrole] (consulted on April 30, 2015).

Compared with other forms of energy such as hydroelectricity, nuclear power, energy wood, biofuel, solar power and geothermal energy, energy products derived from oil and natural gas have many decisive advantages.

Oil has the following advantages:

- its liquid state makes it easy to handle, transport and transfer from one tank to another;
- it has very high energy density both in terms of mass and volume (in the transportation sector petroleum products thus require fairly small fuel tanks to travel long distances);
- it is chemically stable;
- it can be separated into numerous fractions for a wide array of uses such as fuels, lubricants and materials;
- it is the main raw material in the petrochemical industry;
- it does not freeze, unless it is very heavy and very viscous;
- it is available in very great quantities on the planet, although discoveries of readily accessible, recoverable reserves are now rarer.

No other fuel or energy vector offers all of these qualities.

The other side of the coin is that oil and the energy products derived from it also have drawbacks. They are hazardous, flammable, toxic products. The use of such products generates greenhouse gases (GHG) and their combustion in poor conditions emits contaminants such as carbon monoxide, ozone, fine particles, sulphur oxide, and nitrogen oxides that engender acid rain and urban smog.

Moreover, internal combustion engines that use fossil fuels are remarkably inefficient from the standpoint of energy since most of the energy is lost in the form of heat.

It is in response to such drawbacks that considerable effort has been invested over time to improve the quality of fuels and the efficiency of burners, furnaces, processes, motors, machines and vehicles.

Natural gas, which, as its name indicates, is in a gaseous state, offers the following advantages:

- it requires little processing between extraction and use;
- like oil, it can be an input for the petrochemical industry;
- it is neither corrosive nor toxic;
- it provides cleaner combustion than any other common fuel such as coal, petroleum products and biofuels in general;
- it allows for rapid control and instant heat;
- it displays lower greenhouse gas (GHG) emission intensity than petroleum products and coal;
- its price in North America is now highly competitive in relation to other forms of fossil or renewable energies;
- its availability and price in North America are not subject to geopolitical disturbances as is the case for oil.

On the other hand, its handling is more demanding and its energy density in a gaseous state is low. Its transportation and use as a stowed fuel and its exporting by liquefied natural gas carrier are more costly. It must then be compressed (at 250 bars, it occupies 1/300th the volume) or liquefied at a very low temperature (1/600th the volume). However, these operations demand quite a lot of energy. The use of compressed natural gas (CNG) and liquefied natural gas (LNG) as a fuel in freight transportation and mass transit is, nonetheless, competitive.

SECTION 2

THE GLOBAL CONTEXT

After World War I, oil became the first energy choice of the world economy. In recent decades, numerous developments both at the continental and international levels have disrupted the fossil hydrocarbon industry. Geoeconomic and geopolitical pressure, significant regulatory changes, technological breakthroughs and environmental considerations, among other things, have vastly altered the dynamic surround the production and consumption of petroleum products and natural gas.[2]

At the beginning of the new millennium, the combination of three key technologies—3D and 4D seismic analysis, horizontal directional drilling and hydraulic fracturing—has revolutionized oil and natural gas production. These changes have allowed for the exploitation of unconventional sources of hydrocarbons. Following the rise in oil prices observed in the early 2000s, crude oil production in the United States, which had been declining since the 1970s, increased and could even enable the country to achieve full energy self-sufficiency within a few years. The dramatic rise in natural gas production in North America also stems from these innovations.

The new accessibility of oil and natural gas resources has reduced uncertainty about the security of supply in certain countries, in particular the United States. As a result, it has weakened the power of the Organization of the Petroleum Exporting Countries (OPEC) to set prices. The increase in the availability of natural gas on the American market has caused prices to fall, which has affected electricity prices on the eastern North American market.

THE OIL MARKET

In the early 2000s, oil prices began to rise steadily after remaining at a fairly stable level since the mid-1980s. Political instability in certain producing countries such as Nigeria and Venezuela, limited growth in production outside OPEC, the rapid rise in consumption in the emerging economies such as China and India, and anxiety stemming from the possibility of peak oil are all factors that spurred the revival of rising oil prices at the beginning of the century.

2 Background Document 1, *Tendances mondiales et continentales,* available on the energy policy website [politiqueenergetique.gouv.qc.ca/documentation], presents a detailed description of international trends and dynamics in the energy sector.

Following a record increase in 2008, oil prices plunged brutally with the 2008-2009 recession. Owing to the subsequent slow rebound, prices stabilized at around US$110 a barrel for North Sea Brent in 2011, before falling again starting in the summer of 2014 as a result of abundant supply, weaker-than-anticipated growth in demand, fierce competition between producing countries, and complex geopolitical pressure that is affecting Europe and the Near East.

A number of geopolitical analysts believe that, in the short term, OPEC, led by Saudi Arabia, should attempt to keep prices fairly low, around $70 a barrel, in order to maintain its market share in relation to American and Canadian producers of unconventional oil and offshore oil producers, in particular Venezuela and Brazil, whose production costs are higher. In addition to these dynamics, the International Energy Agency (IEA) is forecasting dampened growth in worldwide demand for oil. The slowdown will stem from a combination of more moderate economic growth in the emerging economies and firmer policies confirmed the world over aimed at reducing GHG emissions and their impact on climate. However, the possibility of disruptive events that affect oil production in the Middle East remains real and could partially offset these trends.

THE NATURAL GAS MARKET

The technological revolution mentioned earlier has sparked a marked increase in the amount of natural gas that the United States produces and a concomitant drop in prices. The United States Energy Information Agency (EIA) anticipates that shale gas reservoirs and tight gas reservoirs will by 2025 account for half and nearly one-quarter, respectively, of US natural gas production.

On the continent, natural gas is transported from wells to users, at relatively low cost, by means of a vast network of gas pipelines. On the other hand, extracontinental trade by liquefied natural gas carriers demands that the gas be liquefied prior to shipment then regasified at the destination, a fairly costly operation. This is one explanation of the significant disparities between world markets.

At the turn of the millennium, the United States, like Québec, believed that it would have to rely on imported liquefied natural gas for natural gas supplies and a number of ports of import were planned or built on the east coast and in the Gulf of Mexico. Given the abundant natural gas supplies released by new exploitation technologies, the United States should cease to be a net importer of natural gas in 2017—such is not expected to be the case with oil—and imports by gas pipeline from western Canada should decline by more than 60% by 2025.[3] Several existing and planned LNG ports of import are being converted into facilities to export natural gas to the lucrative European and Asian markets. The new markets could possibly increase the prices paid here.

3 Energy Information Administration (EIA) (2014). *Annual Energy Outlook 2014* [online] [eia.gov/forecasts/aeo/] (consulted on April 5, 2015).

Abundant production should, however, contribute to maintaining fairly low, stable natural gas prices in North America in the coming decade, which will favour growth in North American demand. According to the International Energy Agency (IEA), worldwide demand for natural gas should rise steadily by roughly 1.6% per year by 2025, which is twice the anticipated growth in demand for oil.[4]

THE CHALLENGE THAT CLIMATE CHANGE IS POSING

Political leaders, major financial institutions and numerous influential entrepreneurs agree that climate change poses the greatest challenge to date that humankind has had to overcome. It is generally recognized that an increase in the concentration of CO_2 and other GHG in the earth's atmosphere, of which 80% stems from the production and use of fossil energies, including coal, is the main cause of the climate change that is already affecting the planet. In 2012, oil and natural gas were responsible for 29% and 14%, respectively, of total worldwide GHG emissions.[5]

In November 2015, France will chair the 21st United Nations Framework Agreement on Climate Change—Paris Climate 2015—which seeks the adoption of an initial universal, restrictive agreement on the climate to maintain global temperature increases below 2°C. The international agreement, which is slated to come into force in 2020, is pursuing the objective that all of the developed and developing nations be committed for the first time to a universal agreement on climate.

4 International Energy Agency (IEA) (2014). *World Energy Outlook 2014*, Paris, 748 pages.

5 Emissions for fossil energies calculated by the ministère de l'Énergie et des Ressources naturelles based on AIE data (2014) [iea.org/publications/freepublications/publication/co2-emissions-from-fuel-combustion-highlights-2014.html]; total emissions: World Resources Institute, CAIT 2.0. 2014, *Climate Data Explorer*, Washington, DC [cait2.wri.org].

SECTION 3

THE QUÉBEC CONTEXT

The global economic context is affecting Québec's economy. The relatively significant share of natural resources and primary processing products, especially aluminium, and the tertiarization of its economy mean that Québec is suffering the after-effects of sluggish American and worldwide economic revival.

In Québec, energy security is essentially an economic challenge. Québec's abundant renewable energy resources and privileged access to substantial hydrocarbon resources in western Canada and, more broadly speaking, the North American continent, are protecting us from the uncertain geopolitical context that prevails in major oil producing countries. On the other hand, the trade balance linked to hydrocarbons—natural gas, crude oil, gasoline, distillates, coal, and so on—is heavily in deficit. It should be noted that three-quarters of the oil consumed in Québec is used in the transportation sector.

As for the fight against climate change, the most recent inventory of Québec's GHG emissions put online on April 10, 2105 indicates that such emissions have declined by 8% in relation to their level in 1990. Québec has, accordingly, exceeded the objective that it set in the wake of the Kyoto Protocol, i.e. to reduce by 6% in 2012 its GHG emissions in relation to their 1990 level.[6]

Fossil energy consumption accounted for roughly 65% of Québec's GHG emissions in 2012. The production (thermal power plant), processing (refining), transportation and distribution of energy and fugitive emissions account for an additional fraction of emissions of about 5% of total emissions. Québec has committed itself to pursuing its efforts to achieve by 2020 a 20% reduction and to closely monitoring the international community's deliberations at the Paris Climate Change Conference 2015 in the fall.

As for pollutant emissions, whether from the standpoint of the fight against acid rain (regulation of the sulphur content of fuels), the reduction of industrial aqueous discharges or air quality in urban environments, Québec, while it already has an enviable record, is pursuing increasingly ambitious targets that call for the energy sector to innovate and surpass itself.

The Québec government's priorities include, in particular, the economy, job creation and fiscal consolidation. It is relying on energy to support corporate competitiveness and foster regional development in Québec. Two major projects will contribute to the attainment of its economic priorities: the revival of the Northern Plan and the *Maritime Strategy,* in which energy figures prominently. Access to forms of energy that are competitive and environmentally-friendly in the territory that the Northern Plan covers is a

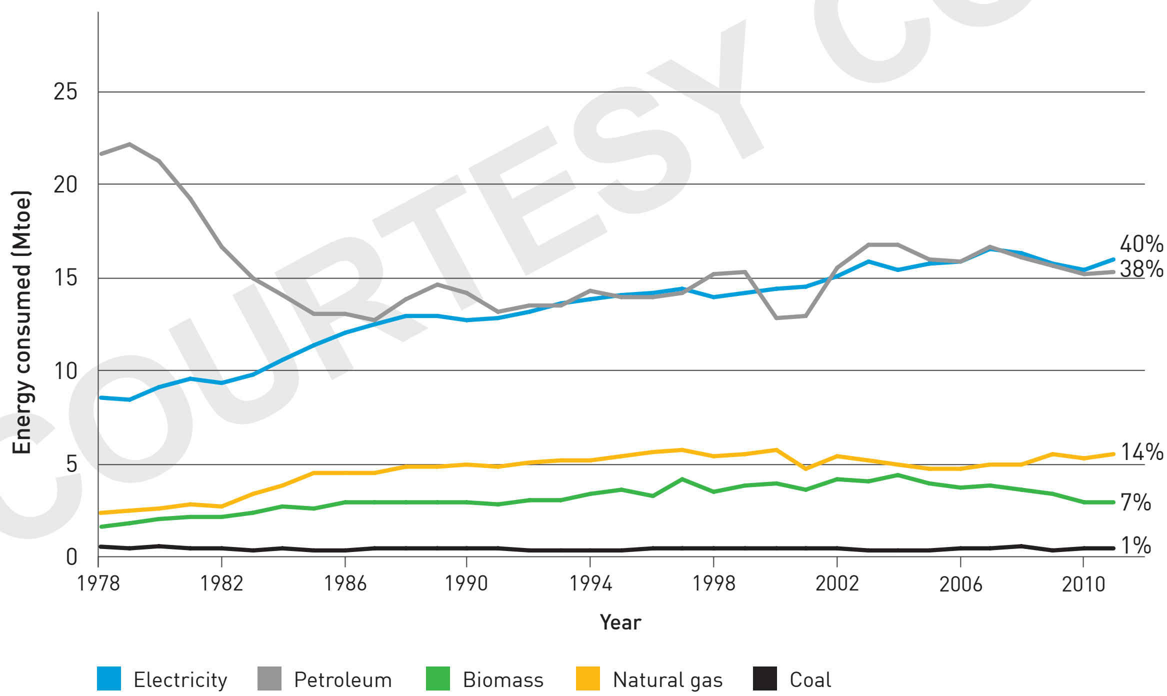
6 Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC) (2015). *Inventaire québécois des émissions de gaz à effet de serre en 2012 et leur évolution depuis 1990* [online] [mddelcc.gouv.qc.ca/changements/ges/2012/inventaire-1990-2012.pdf] (consulted on april 15, 2015).

condition to attract private investments. What is more, part of the marine infrastructure that Québec needs to support its development and energy security will be devoted to the transportation of energy products.

THE ENERGY SITUATION

Québec's energy profile is almost unique in the world because of its hydroelectric generation and extensive forests. Locally produced renewable energies (electricity and biomass), which satisfy 47% of demand, and entirely imported fossil energies (petroleum products, natural gas and coal), which satisfy 53% of needs, almost equally meet current energy demand. Unlike the rest of the world, which depends mainly on fossil energies or nuclear energy for electricity supplies, the electricity consumed in Québec is 99% renewable.

Figure 1.1
Change in the consumption of forms of energy in Québec (1978-2011)



Source: Ministère de l'Énergie et des Ressources naturelles and Statistics Canada

It should be emphasized that oil, which satisfies 38% of Québec's energy needs, accounts for 56% of total GHG emissions. Natural gas satisfies 14% of energy demand and also emits 14% of the province's total GHG emissions.[7]

In Québec, as elsewhere in the world, fossil energies satisfy 99% of transportation sector needs. Fossil energies satisfy 18% and 38%, respectively, of the residential and industrial sectors. The commercial sector relies on hydrocarbons, mainly natural gas, to satisfy 50% of its energy needs.

All projections of energy demand in Québec confirm that hydrocarbons will remain an essential energy source for Québec for several decades, especially in the transportation sector, and an indispensable input in its refining and chemical and petrochemical products industry.

To complete this overview, it should be noted that the sedimentary basins in southern Québec all appear to offer potential for oil or natural gas, or both. Such potential has been proven for certain basins but is speculative in other instances. In all cases, the economically recoverable proportion of the existing potential is unknown but likely represents only a small fraction of total potential.[8]

EXISTING PARALLEL APPROACHES

Aside from the process of adopting a new Québec energy policy, three other government initiatives focusing on hydrocarbons are being carried out:

- the *Government Action Plan on Hydrocarbons*;
- two strategic environmental assessments (SEAs), one a comprehensive assessment of hydrocarbons and the other specific to the Île d'Anticosti;
- the advisory committee on the social acceptability of projects related to natural resource exploitation.

7 GHG emission data are drawn from J. Whitmore and P.O. Pineau (2014), État *de l'énergie au Québec*, and apply to 2012, while the energy ratios apply to 2011.

8 Gouvernement du Québec (2015). *Synthèse des connaissances et plan d'acquisition de connaissances additionnelles*. Report produced within the framework of the comprehensive SEA on hydrocarbons and the specific SEA on hydrocarbon exploitation in Anticosti. [online] [hydrocarbures.gouv.qc.ca/documents/Hydrocarbures.pdf] (consulted on May 5, 2015).

BOX 1

GOVERNMENT ACTION PLAN ON HYDROCARBONS

On May 30, 2014, the government unveiled the key components of its action plan on hydrocarbons. It proposes the following perspective:

- The government favours the development of the hydrocarbons option but it must ensure individual safety and environmental protection.
- Potential must be confirmed, profitability must be ascertained and the best practices must be applied before exploitation is authorized.
- Where warranted, exploitation must be regulated and controlled.
- Exploration and exploitation must elicit the support of the communities concerned.
- We must listen to Quebecers, guide them in their approach and inform them throughout the process.
- The **hydrocarbures.gouv.qc.ca** website provides information on the advancement of the *Government Action Plan on Hydrocarbons*.

Social acceptability is central to the government's perspective of the development of the hydrocarbon option. Before exploration and exploitation work begins, it must elicit the support of the communities concerned. Such support necessarily relies on listening to and guiding individuals, especially by making available to them clear, neutral information, the protection and health and individual safety, environmental protection, the economic profitability of activities for communities and Québec in general, the implementation of the best practices known the world over, an adapted legal framework, and effective control over hydrocarbon development activities.

BOX 2

STRATEGIC ENVIRONMENTAL ASSESSMENTS OF HYDROCARBONS

The production of two SEAs is one of the cornerstones of the *Government Action Plan on Hydrocarbons*. The first assessment is comprehensive and focuses on the hydrocarbon option overall, and the second one is specific to the Île d'Anticosti. Five themes—the environment, the economy, society, transportation and technical aspects—will guide the production of the two SEAs, which are focusing on exploration-related challenges and those stemming from the exploitation or transport of hydrocarbons. They will be used to document all of themes that significantly affect social acceptability, which is crucial to the subsequent development of the hydrocarbon option in Québec.

Accordingly, the SEAs will clarify economically exploitable potential, offset the lack of knowledge on the techniques used, analyze the environmental hazards, and establish the measures to be implemented to minimize them and ensure their sound management. They will also make it possible to inventory the best practices to be established with the industry and partners, study oil and natural gas needs, compare the risks linked to modes of transportation and, lastly, study consultation and collaboration mechanisms that promote acceptance by communities and the sustainable development of the territories.

To ascertain the knowledge lacking in these fields, a review was first conducted of knowledge for each of the themes in the SEAs. For the society theme, in particular, four sections were documented: individual health and safety, questions related to the Aboriginal communities, social and economic repercussions, and social acceptability. The reviews, and a comprehensive summary, were put online on the hydrocarbures.gouv.qc.ca website.

In response to the reviews and to those conducted in the course of the deliberations concerning the economy, the environment, society, technical questions and transportation, the government adopted a plan to acquire additional knowledge. The plan comprises more than 60 studies, some of them carried out internally and others by external mandataries. The findings will be shared with the public as soon as they are available. Two of the studies will sustain reflection on the theme of social acceptability.

The first study, conducted in the context of the comprehensive SEA, will analyze the influencing factors of the social acceptability of hydrocarbon development activities and proposals respecting the method of territorial governance. They will assess how transposable are the success factors defined with respect to methods and processes pertaining to access to information, consultation, public participation and follow-up in the communities affected and the methods of consensus building and partnership governance, in respect of territorial planning and integrated resource management.

The second study is being conducted within the framework of the SEA specific to Anticosti. Based on an empirical research methodology, the study seeks the participation of Anticosti residents to establish a profile of the community, determine its concerns and the anticipated consequences of the development strategies that might be contemplated and, lastly, evaluate the community's adaptability and resilience. The study is part of an inclusive approach and is an effective way to foster reflection and participation by Anticosti residents concerning their vision for the future regarding the development of their territory.

The preliminary SEA reports will be subject to a public consultation process in the fall of 2015. The final reports are expected by the end of 2015.

On November 18, 2014, several days after the launch of the approach leading to a new Québec energy policy, Minister of Energy and Natural Resources Pierre Arcand announced a major undertaking focusing on the social acceptability of projects related to natural resource exploitation. Through the undertaking, the government is seeking, among other things, to adopt practices that will enable industrialists wishing to invest in Québec's territory to develop resources there in a spirit of respect for Quebecers' values.

BOX 3

THE ADVISORY COMMITTEE ON THE SOCIAL ACCEPTABILITY OF PROJECTS RELATED TO NATURAL RESOURCE EXPLOITATION

Concerned with fostering Québec's economic development through the sustainable development of the land and natural resources for which it is responsible, the Ministère de l'Énergie et des Ressources naturelles (MERN) is more fully taking into account the economic, environmental, cultural and social concerns of the communities in the territory.

Accordingly, hydrocarbon exploration and exploitation projects are facing challenges related to their acceptability to residents.

The MERN must at one and the same time take into account the interests of Québec's population and the concerns of individuals likely to be directly affected by the projects, according to the legislative framework in force. It is also coming up against public concern over the oil industry and the role it should play in energy supply and Québec's prosperity.

The objective of the advisory committee on social acceptability of projects related to natural resource exploitation is to review the MERN's practices to ensure dialogue and understanding, defuse disputes and implement projects that will inspire pride and ensure Québec's prosperity.

The approach centres on an analysis of four social acceptability criteria related to the reconciliation of uses and intrinsically linked to the principles of sustainable development, such as participation and commitment, subsidiarity, cost internalization, and so on:

1. the role of local, regional and provincial bodies;
2. participatory approaches;
3. recognition of the social, environmental and economic repercussions of local, regional and province-wide projects;
4. mechanisms to share benefits.

In practical terms, the approach will make it possible to:

- establish a profile of current practices and tools and a diagnosis that allows for the inventorying of strengths and areas for improvement;
- target possible solutions with a view to modernizing the MERN's tools and practices related to the reconciliation of uses in the territory and fostering the social acceptability of development projects focusing on the territory and resources;
- ascertain the perceptions of individuals and organizations concerned by the question through public consultation sessions in five Québec cities. The Aboriginal communities will be invited to participate in this process and special meetings will be organized for the communities that so desire;
- examine the relevant experience in the realm of social acceptability specific to other governments such as Norway, Sweden and British Columbia, and hydrocarbon development or transportation infrastructure projects carried out in Québec over the past decade.

In the long run, this approach will enable the MERN to enhance its practices through an open, transparent, dynamic process.

Departmental policy directions concerning social acceptability are slated for submission in the fall of 2015.

To obtain additional information on the MERN's advisory committee on social acceptability, please visit the **mern.gouv.qc.ca/territoire/acceptabilite** website.

COORDINATION OF THE INITIATIVES UNDER WAY

Both the strategic environmental assessments and the advisory committee on social acceptability are intended to be approaches upstream from specific initiatives focusing on the elaboration of the 2016-2025 energy policy or those centred on a public examination of specific projects related to transportation, such as the Energy East Pipeline, or exploration for hydrocarbon resources. The approaches are changing in tandem and are influencing each other.

Observations concerning the social acceptability highlighted by the SEAs and the advisory committee on social acceptability may sustain the elaboration of Québec's new energy policy. Solutions to enhance receptiveness and the recognition of the perceptions and positions of segments of the population, in particular as regards energy projects, are being proposed and debated therein. Such solutions could facilitate the concretization of the vision for the future that the energy policy will convey with regard to the development of energy options. They could also inspire therein the policy orientations concerning governance, collaboration processes with local authorities, preliminary studies and public examination and consultation processes focusing on energy projects.

SECTION 4

CONSUMPTION

Hydrocarbons account for more than half of Québec's energy balance. Petroleum products satisfy 38% of total energy demand and natural gas, 14%.

Québec's two refineries have a total capacity of 402 000 barrels per day, nearly 20% of Canada's refining capacity. Québec's consumption of refined products is, on the other hand, well below its demographic weight in Canada. The refining capacity of the two refineries in Québec exceeds Québec's consumption, which stands at roughly 289 000 barrels per day. Québec is a net exporter of refined petroleum products. Exports of and interprovincial trade in processed products from Québec refineries are contributing positively to Québec's trade balance.

Table 4.1
List of existing and planned energy product plants intended for final consumption

Owner	Location	Capacity
Refineries		
Suncor	Montréal	137 000 barrels per day
Valero	Lévis	265 000 barrels per day
Natural gas liquefaction plant		
Gaz Métro	Montréal	460 m^3 of LNG per day An expansion project is under way to triple the productive capacity.
Stolt LNGaz inc.	Bécancour	A proposed plant with a capacity of 6 700 m^3 of LNG per day is under study.

Note: Other natural gas liquefaction plant projects are being developed in Québec.
Source: Ministère de l'Énergie et des Ressources naturelles.

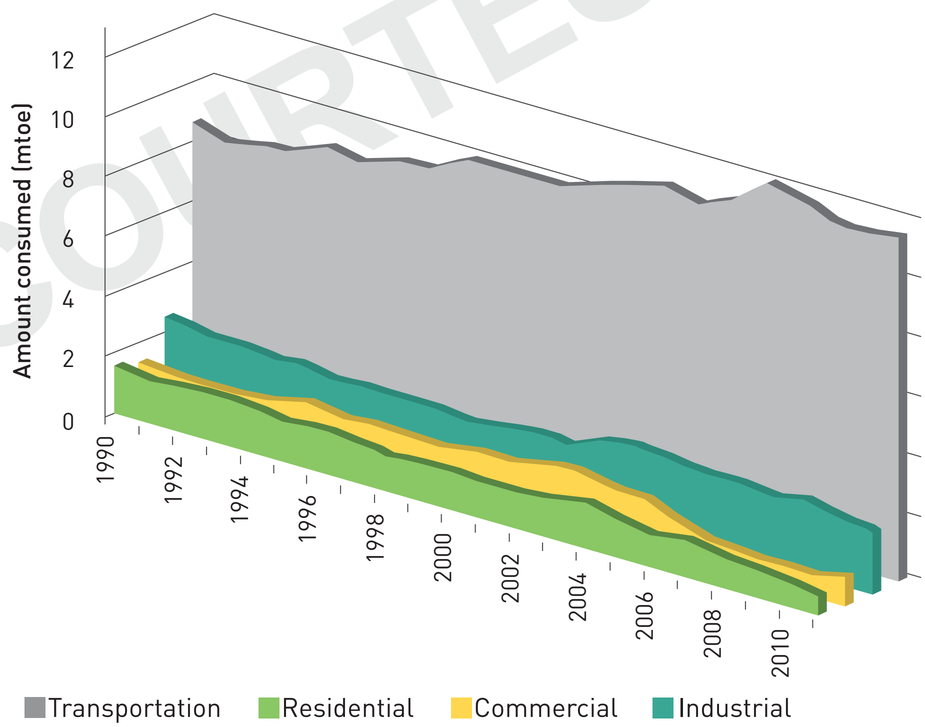
QUÉBEC'S OIL CONSUMPTION PROFILE

As Figure 3.1 in Section 3 indicates, Quebecers' petroleum consumption profile has changed radically since the late 1970s following the commissioning of the La Grande Complex in the James Bay territory and the implementation of major energy efficiency programs and programs to convert building heating systems to electricity, in response to the oil shocks of 1973 and 1979. In one decade (1978-1987), consumption of petroleum products in all sectors dwindled by roughly 40% in favour of electricity, natural gas and biomass.

For the past 25 years in Québec, total demand for energy and petroleum products has grown at an average annual rate of 1%. Oil's share of the energy market has thus remained stable at roughly 40%. The breakdown of consumption between sectors is changing slowly. A growing share of consumption in the residential (4.4%) and commercial (6.4%) sectors is attributed to transportation (75.6%), whose level of activity has grown by 60.7% in 20 years (1992-2011). Demand for petroleum products in the industrial sector is growing at the same pace as it is in Québec and its relative share is remaining fairly constant at roughly 13% (Figure 4.1).

Figure 4.1

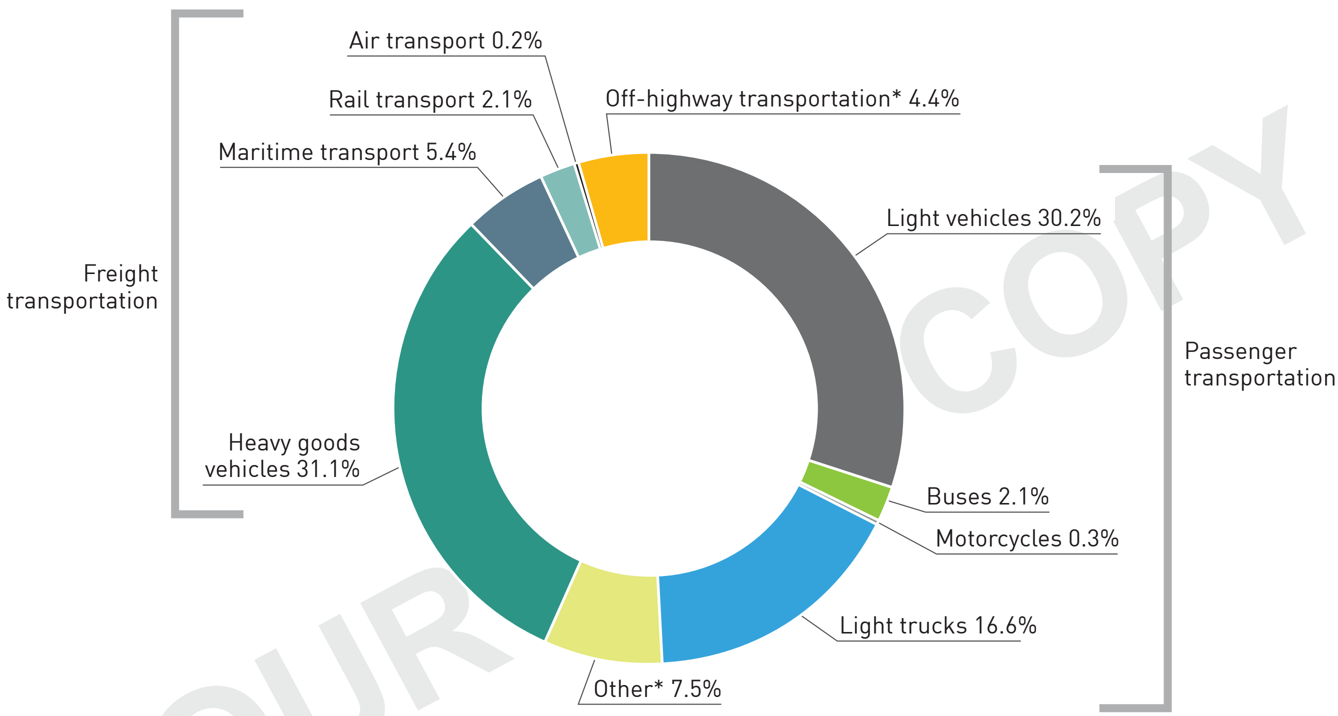
Change in the consumption of petroleum products by area of activity in Québec (1990-2011)



Source: Ministère de l'Énergie et des Ressources naturelles.

Figure 4.2 shows in detail the breakdown of energy consumption in the transportation sector. Vehicles and light trucks used to transport passengers in addition to heavy trucks carrying freight account for the biggest shares.

Figure 4.2
Energy consumption by type of vehicle and mode of transportation in Québec, 2011



* The "Off-highway transportation" category includes vehicles that are not registered to travel on highways, such as snowmobiles and golf carts. It is included in neither the passenger transportation nor the freight transportation category.
** The "Other" category includes air passenger transportation, interurban passenger transportation, and so on.
Sources: Ministère de l'Énergie et des Ressources naturelles and Natural Resources Canada.

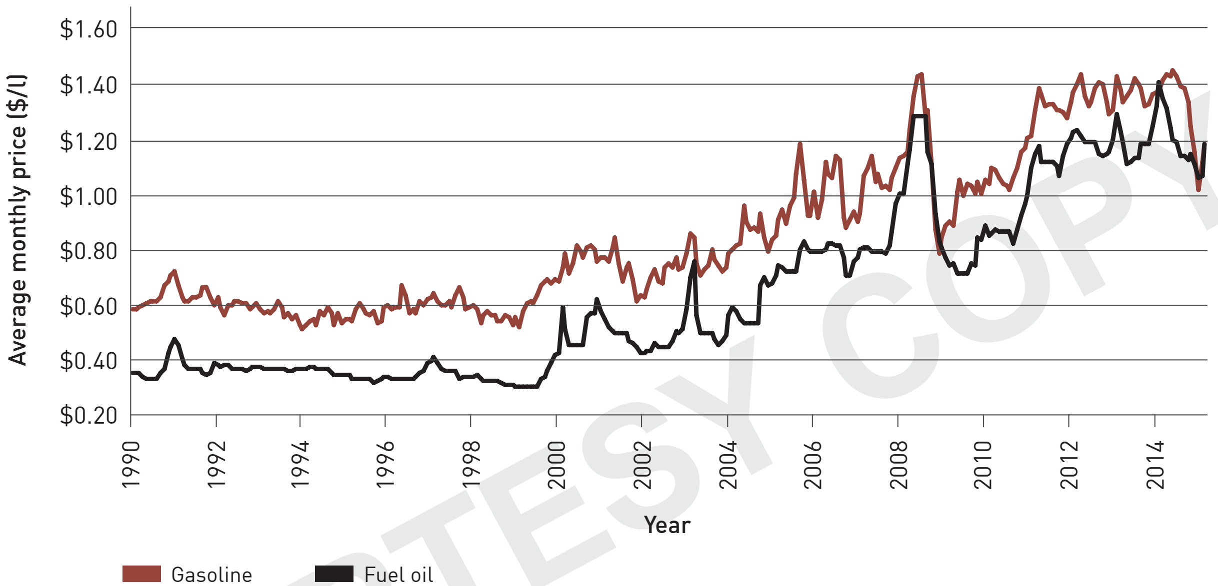
For the transportation sector overall, the MERN anticipates relatively stable energy demand until 2021 and a reduction in total energy consumption in the passenger transportation sector and an increase in the freight transportation sector.

Fuel (gasoline and diesel) accounts for nearly two-thirds of the consumption of refined petroleum products. Several other products are also used, in particular petroleum coke, stripping gas, aviation fuel, fuel oil and propane.

CHANGES IN THE PRICE OF PETROLEUM PRODUCTS

The cost of crude oil is one of the key factors that affect the retail price of petroleum products. In recent decades, oil prices have been highly volatile.

Figure 4.3
Changes in gasoline and fuel oil prices in Montréal (1990-2015)



Source: Statistics Canada.

The two Québec refineries recently turned to North American West Texas Intermediate (WTI) crude oil, which is cheaper than North Sea Brent crude oil.

Three other factors decisively affect fuel petroleum products in Québec, i.e. the relative value of the Canadian dollar in relation to the American dollar, the continental integration of the fuel market, which is tending to harmonize prices in relation to New York, and the level of taxation of petroleum products. In Montréal, federal and provincial taxes account for roughly one-third of the price at the pump. Accordingly, the relative devaluation of the Canadian dollar in relation to the US dollar is contributing to the increase in price of crude oil denominated in US dollars.

THE ENERGY EFFICIENCY OF OIL

Energy efficiency in respect of oil and petroleum products applies to refining and final consumption. For example, the Jean Gaulin refinery (Énergie Valero) has reduced its energy intensity by 17% in relation to the 1990 level. This sound performance, the best in Canada, has been achieved at the price of substantial investments.[9]

As for efficiency in the final consumption of petroleum products, the repercussions of efforts made in the past 10 years have not lived up to expectations. Energy efficiency gains by petroleum products have been exceeded by the increase in the level of activity in all sectors, but above all in the transportation sector, the biggest consumer of petroleum products.[10]

The transportation sector accounts for 38% of the net energy losses observed in Québec (roughly 373 PJ in 2012). The refining of petroleum products accounts for roughly 10% of the additional losses (101 PJ in 2012).

Several government initiatives are already seeking to improve energy efficiency and reduce reliance on fossil energies where other options are available to consumers, including standards governing vehicle fuel consumption, the *2013-2020 Climate Change Action Plan* and the *Transportation Electrification Strategy.*[11] Other initiatives may be proposed within the framework of the forthcoming Québec energy policy.

QUÉBEC'S NATURAL GAS CONSUMPTION PROFILE

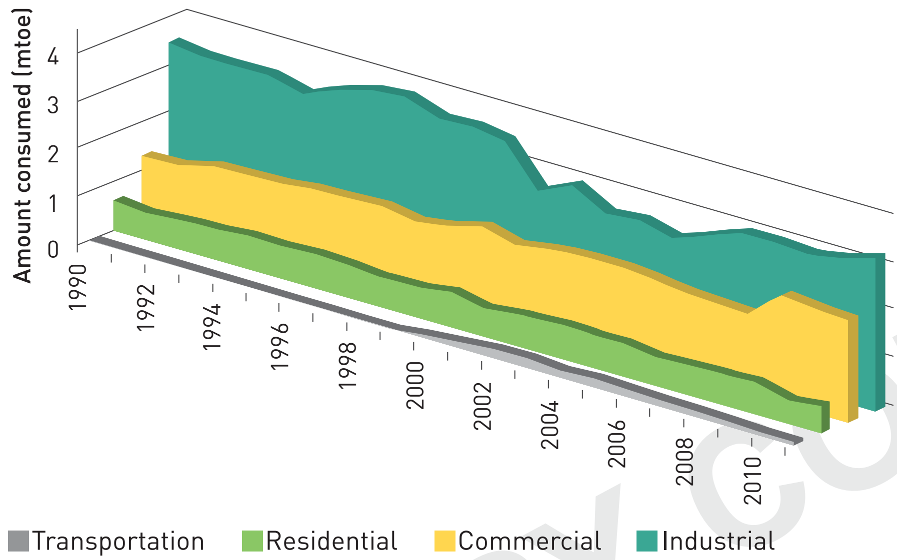
The significant increase in natural gas production in North America and the concomitant reduction in the price of natural gas on the market have contributed to a marked upturn in its use in the United States, especially for heating and electricity generation. This change has had a great deal less impact in Québec, where natural gas is consumed primarily by industry and to heat commercial buildings. The investments required to convert equipment to natural gas are limiting the pace at which consumers react to the unforeseeable and relatively sudden fluctuations observed on the North American natural gas market.

9 According to an industry representative, such investments appear to have totalled roughly $875 million since 2002.

10 Background Document 3, *Energy Efficiency and Innovation,* available on the energy policy website [politiqueenergetique.gouv.qc.ca/documentation], examines energy efficiency in greater detail.

11 Background Document 5, *The Decarbonization of Road Transport,* available on the energy policy website [politiqueenergetique.gouv.qc.ca/documentation], examines in greater detail the use of hydrocarbons in the transportation sector.

Figure 4.4
Change in the consumption of petroleum products by area of activity in Québec (1990-2011)



Source: Ministère de l'Énergie et des Ressources naturelles.

Natural gas satisfies roughly 14% of total energy demand. It satisfies 30% of needs in the commercial sector, 18% in the industrial sector and 7% in the residential sector, and less than 1% of consumption in the transportation sector.[12]

While natural gas now accounts for a negligible portion of the energy that the transportation sector consumes, the fuel, in liquefied or compressed form, is highly competitive and offers significant environmental advantages in relation to fuel petroleum products. Its broader availability boosted by Gaz Métro could enable it to capture some market share in the coming years.

12 Ministère de l'Énergie et des Ressources naturelles, data for 2011.

BOX 4

THE CIRCULAR ECONOMY, TRANSPORTATION AND HYDROCARBONS

According to the Agence de l'environnement et de la maîtrise de l'énergie, the circular economy is an economic system of trade and production, which, at all stages in the product life-cycle seeks to increase the efficiency of use of resources and reduce environmental impact while ensuring individual well-being.

The circular economy is gradually being implemented at the international level but more intensively in Europe and Asia. It offers a coherent framework for an array of business strategies and all manner of governmental measures and initiatives aimed at more sustainable development. Accordingly, the establishment of predefined targets on the productivity of specific resources helps to reduce per capita resource consumption and maintain or even increase the level of well-being of the population. The circular economy thus constitutes a paradigm shift in relation to the current so-called "linear" economic model in which resources are, by and large, extracted, processed, consumed and discarded. The latter model thus encourages wasting of resources since wealth creation hinges on the biggest number of units produced by unit of time to satisfy given demand.

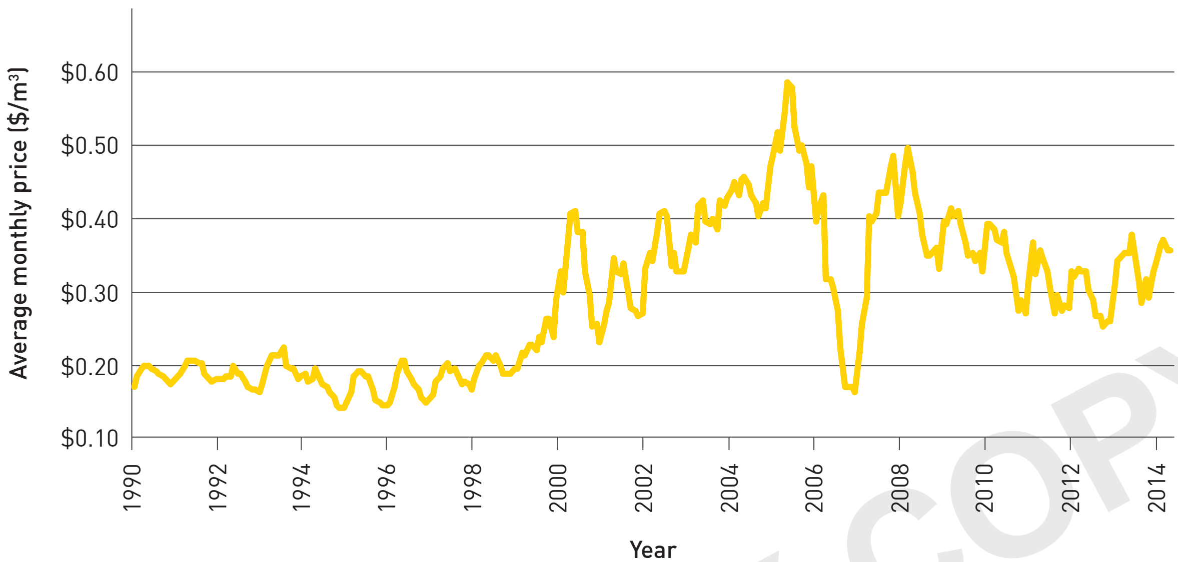
The transportation sector uses nearly one-third of the total energy consumed in Québec and produces more than 40% of total GHG emissions. Significant effort is thus necessary to substantially increase the efficiency of the vehicles operated on Québec roads. At present, privately-owned motor vehicles are used, on average, one hour per day per individual. The potential for productivity gains is thus very considerable. Unlike the linear economy, which encourages the most extensive production possible of vehicles, a circular economy targets, first and foremost, the service rendered instead of goods by fostering, for example, carpooling and car sharing. Such an approach, which emphasizes the quality and cost of the movement of individuals and freight, also promotes the use of mass transit and active transportation instead of personal vehicles.

For Québec, this means supporting the emergence of new business models made possible by the advent of mobile applications such as Communauto, Car2Go, and so on, and the development of new technologies that foster better use and integration of transportation-related resources. Combined with a strategy in the longer term to electrify transportation, this array of solutions stemming from the circular economy is part of an energy policy geared to sustainable development.

CHANGES IN THE PRICE OF NATURAL GAS

Contrary to crude oil, the price of natural gas in Québec has been tied for decades to that in Western Canada. Today, the reference price is continental. Québec prices remained relatively high in the past given the need to transport over a long distance supplies from Western Canada.

Figure 4.5
Changes in the price of natural gas (1990-2014)



Source: Statistics Canada.

Given the abundance of natural gas in the United States, in the short and medium term Québec consumers should benefit from a fairly low price. The distances between the producing zones and Québec are fairly short. A number of companies, such as TransCanada, Enbridge and Spectra Energy, are investing heavily to send gas from deposits in the Marcellus and Utica shale deposits in Pennsylvania, Ohio and West Virginia to Ontario and Québec. Possible Québec production should not affect the prices that Québec consumers pay.

THE ENERGY EFFICIENCY OF NATURAL GAS

Natural gas distributors must submit annually their energy efficiency enhancement plans to the Régie de l'énergie. The programs that stem from the plans may, for example, target the overhaul of the mechanical systems of buildings (heating, ventilation and air-conditioning), or any broader use of new technologies that achieve greater energy efficiency.

Between 2008 and 2014, Gaz Métro thus invested $93.5 million in energy efficiency and innovation and Gazifère spent $2.3 million for the same purpose. During the period covered by the *Québec Energy Strategy 2006-2015,* the natural gas sector achieved its energy efficiency objective, allowing for 13 PJ in cumulative energy savings between 2008 and 2014. Mention should also be made of energy conservation stemming from the energy efficiency programs of the Ministère de l'Énergie et des Ressources naturelles.

SECTION 5

TRANSPORTATION AND SUPPLY

Québec does not currently produce any hydrocarbons. It obtains oil and natural gas supplies from the producing provinces and countries. Private companies, of which the main ones are Valero and Suncor in the case of oil, and Gaz Métro and Gazifère as regards natural gas, ensure supplies. In addition to these firms, other oil companies and certain wholesalers import, purchase and distribute refined petroleum products, mainly from Europe, the United States and the other Canadian provinces. Supplies are subject to market fluctuations and the availability of specialized transportation infrastructure such as pipelines, oil tankers and liquefied natural gas carriers, railroad lines and rolling stock controlled by private companies (TransCanada, Enbridge, Canadian Pacific, Canadian National, shipowners, and so on). Consequently, the profile of suppliers occasionally fluctuates significantly from one year to the next, as was recently the case and will be so again, in the short term, with the rapid development of unconventional resources, fluctuations in world oil prices, and the reversal of the flow of Enbridge's 9B pipeline.

OIL SUPPLIES AND PRICES

The crude oil used in Québec is shipped by train, ship and oil pipeline to the Énergie Valero (Lévis) and Suncor (Montréal) refineries. It is converted into refined products, in particular gasoline, diesel and aviation fuel, but also fuel oil, asphalt, petrochemical feedstocks and other petroleum-based products.

Over the past decade, oil was mainly sent to Québec refineries by boat and travelled on some 1 500 km of the Québec portion of the St. Lawrence River. In 2011, hydrocarbons loaded and offloaded in Québec ports totalled 27 million tonnes, i.e. 54% in the Québec City region and 37% in the Montréal area. More than 250 oil tankers ensured Québec's annual crude oil supplies until 2013. Nearly half of the oil arrived from Africa (Algeria, Angola and Nigeria) and the remainder was supplied by North Sea producers (12%), the United States (9%) and Mexico (7%). Smaller suppliers rounded out the supplies, including Western and Eastern Canada, which provided roughly 5% of the oil refined in Québec.

Since 2013, importers have attempted to profit from the persistent gap between the price of Alberta oil, indexed on West Texas Intermediate, and North Sea Brent crude oil, the reference for crude oil purchases abroad. The price difference was strengthened by the increase in production of American oil companies. Accordingly, in 2014, the United States supplanted Algeria as the main source of Québec's crude oil imports, which is attributable to the growing availability of resources from oil production in tight reservoirs in North Dakota, Texas, New Mexico and Colorado. At present, crude oil from the United States is relatively less expensive than offshore crude oil. Imports from the United States thus increased considerably during the first eight months of 2014 and account for nearly half of all crude oil imports in Canada.

Bearing in mind the new context of oil prices, it has been noted that supplies are now coming increasingly from the United States and Western Canada, thereby favouring rail transportation and necessitating the use of special loading and unloading terminals. What is more, for Canada overall, the transportation by railway tank car of crude oil has increased since 2008 because of the inadequacy of the pipeline network, which has not kept pace with growth in North American oil production. The truck-to-railcar transloading service initially offered has shifted to a unit train service supplied by reservoirs connected to the pipelines.

To accept oil by land route, the Suncor refinery has built a rail terminal with a nominal capacity of 36 000 barrels per day, which has been in operation since early 2014. The Énergie Valero refinery obtains crude oil from Texas and North Dakota by maritime transport and, more recently, from Western Canada by rail.[13] Lastly, the authorized reversal of flow in Enbridge's 9B oil pipeline will mean that the two Québec refineries could entirely obtain supplies of Canadian and American oil by the end of the year. The development of infrastructure to handle the oil has required investments of nearly $20 million at the Énergie Valero terminal and at the Suncor terminal in Montréal-Est.

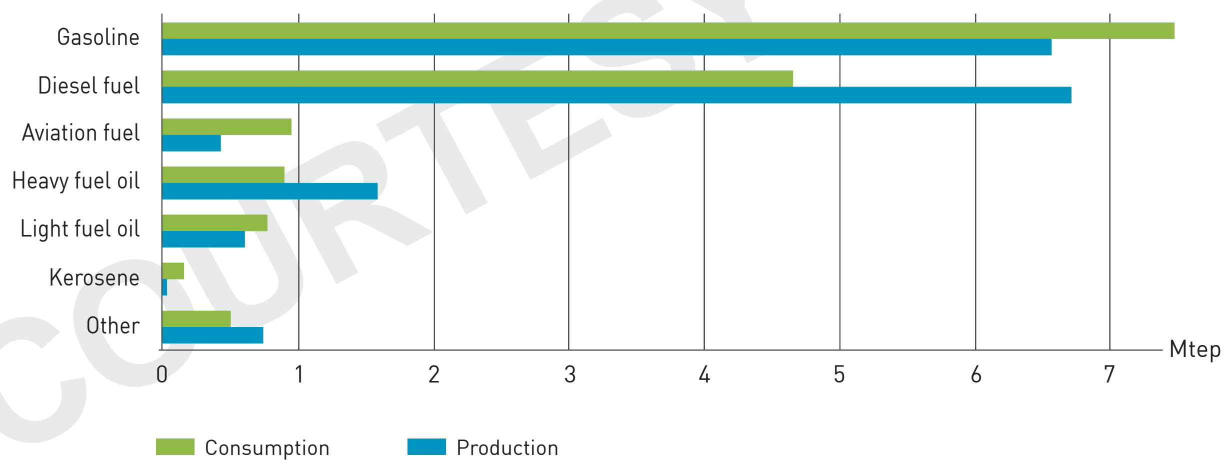
It should be noted that in Canada interprovincial or transborder pipelines fall under federal jurisdiction and are regulated by the National Energy Board (NEB). Intraprovincial pipelines fall under provincial jurisdiction.

13 Center for Interuniversity Research and Analysis of Organizations (CIRANO) (2015). *Bilan des connaissances. Transport des hydrocarbures par modes terrestres au Québec*, 405 pages.

For Canada as a whole, the NEB estimates at more than $134 billion the value of hydrocarbons transported in 2013 by pipelines under its responsibility, at an approximate cost of $7.1 billion. The Portland-Montreal Pipe Line now supplies the Suncor refinery in Montréal. Since 2012, the Pipeline Saint-Laurent has carried refined petroleum products from Lévis to the Greater Montréal area. Trans-Northern Pipelines Inc. operates a pipeline linking Montréal and Oakville, Ontario, which transports refined petroleum products such as gasoline, diesel, aviation fuel and fuel oil. Deliveries by pipeline of petroleum products in Québec stood, for the first nine months of 2014, at 5.9 million m^3, of which 85% came from Québec refineries and the remainder from outside Québec.[14]

Petroleum products account for more than half of hazardous materials road shipments in Québec, although this represents a very small percentage of total truck traffic.[15] In 2014, a network of 2 891 gasoline service stations distributed gasoline, diesel fuel and propane in Québec. The number of service stations has fallen since 2008, despite steady increases in sales at the pump.[16]

Figure 5.1
Comparison of consumption and local production of petroleum products in 2011



Note: The "Other" category includes liquefied petroleum gas (propane and butane), aviation gasoline, stripping gas and petroleum coke.
Sources: Ministère de l'Énergie et des Ressources naturelles and Statistics Canada.

14 Statistics Canada (2015). *Tableau 133-0003 — Sommaire du transport, par pipe-lines, mensuel (mètres cubes)* [online] [www5.statcan.gc.ca/cansim/a05?lang=fra&id=1330003] (consulted on April 28, 2015).

15 Center for Interuniversity Research and Analysis of Organizations (CIRANO) (2015). *Bilan des connaissances. Transport des hydrocarbures par modes terrestres au Québec*, 405 pages.

16 Statistics Canada (2015). *Tableau 080-0023 — Enquête annuelle sur le commerce de détail, estimations financières fondées sur le Système de classification des industries de l'Amérique du Nord (SCIAN) par genre de magasin* [online] [www5.statcan.gc.ca/cansim/a26?lang=fra&retrLang=fra&id=0800023&paSer=&pattern=&stByVal=1&p1=1&p2=38&tabMode=dataTable&csid=] (consulted on April 28, 2015).

BOX 5

REVERSAL OF PIPELINE 9B AND THE ENERGY EAST PIPELINE PROJECT

Two projects concerning oil pipeline transportation infrastructure have a direct impact on Québec.

The first project is the reversal of Enbridge's 9B pipeline between North Westover, Ontario, and Montréal. The NEB has approved the project subject to conditions. The NEB is expected to issue the requisite authorizations by the end of 2015 and thereby enable Enbridge to put its oil pipeline back into service.

The second project is the Energy East Pipeline proposed by TransCanada Pipelines Limited (TCPL). The project would offer a second transportation option for Western Canadian oil to refineries in Québec and New Brunswick and would allow for offshore exports of oil from Western Canada. In addition to converting a gas pipeline linking Alberta and Iroquois, Ontario into an oil pipeline (3 000 km), the project calls for the construction of a new 1 460-km pipeline to New Brunswick, 723 km of it in Québec. The final version of the project has not yet been made public.

The project is facing several technical, environmental and societal challenges. The NEB will not hand down a decision on the project before 2017. The Québec and Ontario governments have defined a shared approach to analyze it, which seeks to ensure that, if the project proceeds, it optimizes spinoff in the economy of Eastern Canada and generates fair spinoff for communities in a spirit of respect for individual safety and environmental protection. It must be subject to exemplary prevention, follow-up and risk management measures. In Québec, the promoters must abide by legislation as regards participation by and the consultation of the Aboriginal communities. The government will also ensure that it ascertains the concerns of the individuals affected from the standpoint of security and environmental protection, in particular through a mandate assigned to the Bureau d'audiences publiques sur l'environnement (BAPE).

Another mandate has already been assigned to the Régie de l'énergie to assess the Energy East Pipeline project's repercussions on the reliability of natural gas supplies in Québec. In its opinion released on January 7, 2015, the Régie indicated that the Energy East Pipeline project is desirable inasmuch as it consists in converting natural gas transportation facilities that are now underutilized. However, the Régie believes that it would be more prudent for TCPL to ensure by means of a new call for proposals open to all shippers that the requisite natural gas transportation capacities are properly established. Moreover, the Régie is of the opinion that the oil shippers who will benefit from the project should share the costs and risks linked to the gas section of the project. Accordingly, TCPL should review the project to ensure that gas shippers will not cross-subsidize the oil section of the project and that they will not have to assume greater risk than at present.

NATURAL GAS SUPPLIES AND TRANSPORTATION

Québec's natural gas imports hover around 6 billion m^3 per year. Natural gas is entirely transported by gas pipeline to Québec, where five companies operate the gas pipelines to transport and distribute natural gas. A fraction of the natural gas that Québec receives is liquefied for storage to ensure additional supplies during the winter peak period. The LNG produced also supplies The Blue Corridor, a network of vehicle refuelling stations in Eastern Canada, and certain industrial customers not served by the natural gas pipeline network. The Côte-Nord, Nord-du-Québec, Bas-Saint-Laurent and Gaspésie regions and certain regional county municipalities (RCMs) such as Bellechasse are not integrated into the natural gas distribution network, which poses both an economic and an environmental challenge for the industrial sector.

Until recently, the Western Canadian sedimentary basin supplied almost all of the natural gas consumed in Québec. It was transported by the TransCanada Pipelines Limited and Trans Québec & Maritimes Pipeline Inc. network to the distributors. With the extensive exploitation of the Marcellus and Utica shale deposits in the United States, the main Québec distributor, Gaz Métro, is increasingly obtaining supplies in the United States, which allows it to save on transportation costs. This marks a significant change in relation to the historical situation. While the maximum capacity of the Canadian transportation system is 200 million cubic meters per day, deliveries from Alberta and Saskatchewan plunged by half between 2000 and 2014.[17] Increased American production has encouraged distributors in Eastern Canada to not renew contracts that represent significant portions of transportation capacity reserved by contract.

Growth in supply from the United States has plunged prices to a level below that of conventional gas from Western Canada, which has led to the collapse of drilling and gas production activities in the region. On the other hand, demand for natural gas to develop the Alberta oil sands has risen rapidly and is providing Western Canadian producers with a market.

In Québec, two natural gas distributors occupy the entire market, i.e. Gazifère, solely in the Outaouais region, and Gaz Métro for the rest of the province. The integration of the natural gas market and the private nature of the transactions conducted make it difficult to obtain information on the precise source of their supplies. However, the Quebec industry has indicated that it was contemplating obtaining 75% of natural gas supplies from the United States in the coming years.

17 TransCanada (2015). *Fourth Quarter News Release 2014* [online] [www.transcanada.com/docs/Investor_Centre/2014_TCC_AR_Eng.pdf] (consulted on April 28, 2015).

Gazifère, which serves 38 500 customers, operates 886 km of pipelines in the Outaouais region, while Gaz Métro supplies more than 195 000 customers through its natural gas pipeline network spanning more than 10 000 km. For Gaz Métro, this figure includes 7 000 industrial customers and 45 000 commercial and institutional customers.[18] In *Budget 2015-2016,* the Québec government announced the attribution of $38 million aimed as a matter of priority at the proposal to extend the Québec natural gas distribution network between Lévis and Sainte-Claire in the Bellechasse region. The federal government also announced its intention to contribute financially to the project.

In Québec, natural gas's market share will increase given the government's desire to support the distribution of LNG to industries in regions not served by gas pipeline, such as the Nord-du-Québec and the Côte-Nord regions. Investors are also studying proposed natural gas liquefaction plants to serve export markets.

REGULATION OF TRANSPORTATION

In Canada, the National Energy Board regulates projects and determines the criteria that must structure international and interprovincial pipeline transportation, in collaboration with the Canadian Environmental Assessment Agency from the standpoint of the environmental aspects of certain projects. The federal government is also establishing several rules aimed at oversight of rail and maritime transport. The provinces also assume part of the responsibility for the regulation of the means of transportation. Local and provincial Québec institutions intervene to manage incidents, in addition to ensuring the training of intervention teams and site restoration.

The recent increase in the transportation of oil by rail, along with the Lac-Mégantic tragedy that killed 47 people when a train transporting crude oil derailed in 2013, has encouraged the federal government to amend several regulations governing rail transport. The changes affect the standards governing the rail tank cars used to transport oil. A bill aimed at establishing a minimum insurance coverage threshold for possible physical and environmental damage in the event of an accident is also under study. The bill calls for the establishment of an additional compensation fund to be maintained by shippers to cover damage that exceeds the requisite amount of insurance. On May 1, the Government of Canada and the United States government announced the adoption of new, safer construction standards for railway tank cars transporting flammable liquids.

Maritime transport on the St. Lawrence River is mainly governed by rules established by Transport Canada. In 2013, the authorized width of oil tankers navigating the St. Lawrence River between Montréal and Québec City was increased from 32 m to 44 m. The change sought to ensure a more competitive position for the Port of Montréal.

18 Gaz Métro (2015). *Gaz Métro en bref* [online] [www.corporatif.gazmetro.com/salle-de-presse/] (consulted on May 5, 2015).

In the fall of 2014, Suncor sent Western Canadian oil by rail to the Kildair reservoir in Sorel-Tracy, where it was loaded on to oil tankers for export. While the drop in oil prices has interrupted such changes since then, the activity might resume when prices are higher.

The reversal of Enbridge's 9B pipeline and TransCanada's Energy East Pipeline project both respond to the increase in the transportation of crude oil from the western to the eastern part of the continent to satisfy Ontario's and Québec's needs and, in the case of the TransCanada project, to facilitate exports. The existence of several pipeline projects to transport hydrocarbons encouraged the federal government to propose on December 8, 2014 a bill on pipeline safety. Bill C-46 proposes the establishment of an accountability regime, in the absence of proof of fault or negligence, at a minimum of $1 billion for the biggest companies. It also allows for the establishment of a tribunal responsible for examining claims for compensation pertaining to damage stemming from a spill.

The questions of supply and transportation are interrelated. Québec's oil consumption and its environmental impacts are indissociable from consumption that occurs downstream. Both the origin of hydrocarbons and their mode of transportation in Québec must be analyzed at the same time as changes in demand.

SECTION 6

NATURAL GAS AND OIL PRODUCTION

Oil and gas exploration activities have been carried out in Québec's territory for several decades. The Gaspésie, St. Lawrence Lowlands and Île d'Anticosti regions have been recognized as being suited to the presence of hydrocarbons. Several companies have operated in the past in the territories.

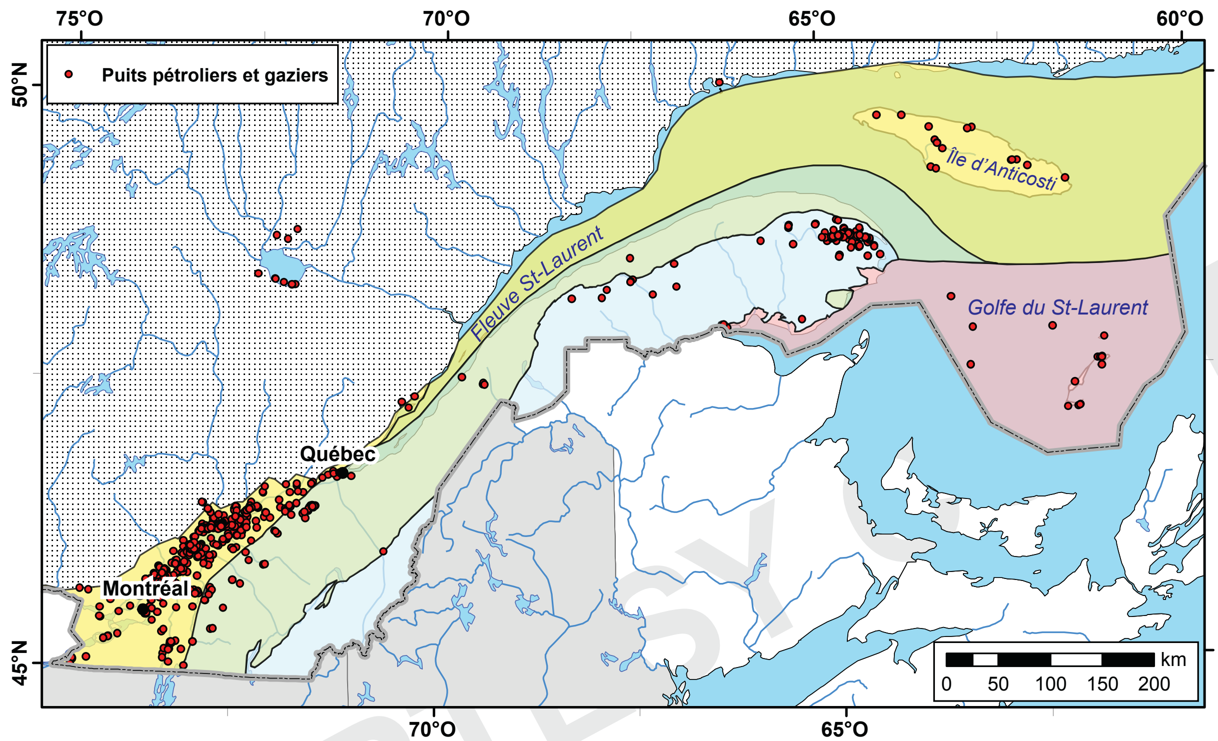
The likely presence of subsurface hydrocarbons in Québec makes it possible to contemplate the possibility of producing oil and natural gas locally, which would at one and the same time enhance Québec's trade balance and develop an oil and gas industry and specialized expertise in the industry. However, the very notion of developing a hydrocarbon industry must come to terms with concerns related to the environment, the territory, the host communities, public health and the economic profitability of projects.

The quest of potential hydrocarbon resource development is complex and warrants special attention. Knowledge of the resources and possible quantities of hydrocarbons and the consequences of their possible extraction are still uncertain. As indicated earlier, strategic environmental assessments are under way, which will enhance existing knowledge.

KNOWN AND POTENTIAL RESOURCES

No major commercial hydrocarbon extraction activity is under way in Québec although several regions have significant onshore and offshore potential, which has aroused the interest of several companies in Québec's oil and natural gas resources.

Figure 6.1
Map of the sedimentary basins in southern Québec and the oil and gas wells drilled in the territory



Legend:

St. Lawrence Platform basin:
- St. Lawrence Lowlands sub-basin
- Anticosti sub-basin

Appalachian Cambro-Ordovician basin

Gaspésie Siluro-Devonian basin

Magdalen Permo-Carboniferous basin

Source: Bédard et *al.*

Knowledge varies concerning the potential hydrocarbon resources of the territories and the economic and environmental hazards related to their extraction. Table 3 and Table 6.2 summarize them.

Table 6.1
State of knowledge of Québec's potential onshore hydrocarbon resources

Region	Type of hydrocarbon	Likely extraction technique	Remark
St. Lawrence Lowlands	Shale gas, possibility of unconventional oil	Horizontal drilling and hydraulic fracturing	Current knowledge indicates that the Utica Shale is insufficiently porous to allow for conventional exploitation. According to analyses, the hydrocarbons therein comprise mainly natural gas, although drilling has detected small amounts of shale oil.
	Conventional natural gas	Extraction of conventional natural gas	Natural gas deposits have been discovered and exploited in the past in the St. Lawrence Lowlands.
Île d'Anticosti	Potential for shale oil, unconventional gas and oil in conventional reservoirs	Horizontal drilling, hydraulic fracturing and extraction of conventional oil	Unlike the St. Lawrence Lowlands, the oil and gas resources on the Île d'Anticosti remain theoretical. A report submitted to Pétrolia estimates at 30.9 billion barrels the potential theoretical resources but stipulates that it is premature to speculate on the presence or absence on the island of recoverable oil. For the time being, oil and gas exploration under Anticosti S.E.C.'s hydrocarbon exploration licence apparently targets the Macasty Shale, which appears to include shale oil and, potentially, shale gas. However, Junex is also targeting conventional oil in older, deeper geological units than the Macasty Shale.
	Potential for oil and natural gas in conventional reservoirs	Extraction of natural gas	Exploration work has revealed source rock that appears to have oil and gas potential in the southwestern portion of the island, where thermal maturity is stronger.
Gaspé Peninsula	Potential for oil and natural gas in conventional reservoirs	Extraction of natural gas and oil	This region is historically recognized for its conventional oil and natural gas reservoirs. For the time being, the Galt deposit, the first to have undergone horizontal drilling in Gaspésie and to have delivered a commercial production rate, is targeted for hydrocarbon exploitation. Exploration work is continuing at the Haldimand and Bourque properties.
	Potential for unconventional oil and natural gas	Horizontal drilling and hydraulic fracturing	
Bas-Saint-Laurent	Potential for oil and natural gas in conventional reservoirs	Extraction of natural gas and oil	Analyses of total organic carbon (TOC) offer evidence of hydrocarbons in the region.
	Potential for unconventional oil and natural gas	Horizontal drilling and hydraulic fracturing	

Source : CIRAIG

Table 6.2
State of knowledge of Québec's potential offshore hydrocarbon resources

Region	Type of hydrocarbon	Likely extraction technique	Remark
St. Lawrence estuary	Potential for oil and natural gas in conventional reservoirs	Offshore extraction of oil and gas	Seismic data are of very poor quality and do not allow the territory's potential to be adequately evaluated. However, natural gas, at the very least, appears to be present in the region following the observation of numerous vents from natural gas escapes.
Gulf of St. Lawrence (Old Harry), including the Îles-de-la-Madeleine	Potential for oil and natural gas in conventional reservoirs	Offshore extraction of oil and gas	The Gulf of St. Lawrence sector (including Old Harry) is often associated with the presence of oil, but natural gas is also found there: certain sectors may have oil and natural gas, thus making exploration for the two hydrocarbons indissociable.

Source : CIRAIG

All of the sedimentary basins in southern Québec appear to have oil or gas potential, or both. Partial estimates of the potential of certain reservoirs have been made.[19] The St. Lawrence Lowlands are among the best known. The evaluation of potential resources is the most advanced in the Gaspé Peninsula, which is approaching the commercial exploitation phase. While exploration there is preliminary, current data suggest that the Gulf of St. Lawrence region might reveal geological reservoirs containing hydrocarbons, including the Old Harry site, located on the Québec-Newfoundland and Labrador border. As for the Île d'Anticosti, the main activities are concentrated at the depth of the Macasty Shale, which may contain oil and shale gas.

Data respecting the St. Lawrence estuary and the Bas-Saint-Laurent region are insufficient to conclude that they have significant recoverable resources or the economic profitability of their exploitation.

At present, the state of knowledge makes it difficult to assess Québec's hydrocarbon resource potential and the possible benefits that it might engender. The theoretical potential is, nonetheless, considerable. Uncertainty over potential reserves at this stage of exploration is not unique to Québec. It is fairly usual in newly explored territories in the world.

19 Gouvernement du Québec (2015). *Synthèse des connaissances et plan d'acquisition de connaissances additionnelles*. Report produced within the framework of the comprehensive SEA on hydrocarbons and the specific SEA on hydrocarbon exploitation in Anticosti. [online] [hydrocarbures.gouv.qc.ca/documents/Hydrocarbures.pdf] (consulted on May 5, 2015).

PRODUCTION TECHNOLOGIES AND RISKS

Hazards related to fossil hydrocarbon exploration and exploitation vary. While some surface work hardly disturbs the natural and human environment, this is not true of other work. For example, geophysical techniques such as on-the-ground seismic surveys require the induction of vibrations that can disturb infrastructure. When sufficient buffer zones are not established, noise emissions that can harm wildlife and the local population may be observed. In the same way, local deforestation stemming from the construction of transportation infrastructure necessary to access the sites may be reported. Stratigraphic tests, and oil drilling, can also be accompanied by hazards linked to the migration of fluids along the wells and the rising of gas to the surface.[20]

Well stimulation by means of hydraulic fracturing is required to tap unconventional oil and natural gas potential. The technique increases the permeability of rock surrounding the well. Large quantities of fluids are injected, usually a mixture of water, sand and chemical additives (roughly 1%). In the St. Lawrence Lowlands during summer low flow, the quantities of water required could pose a threat to farming activities carried out in certain drainage basins of small watercourses.[21] The possibility of recycling the water injected or using brackish water, as is the case in certain other Canadian provinces, might mitigate this type of risk of conflict.

20 Michel Malo, René Lefebvre, Félix-Antoine Comeau and Stephan Séjourné (2015). *Synthèse des connaissances portant sur les pratiques actuelles et en développement dans l'industrie pétrolière et gazière*, Institut national de la recherche scientifique, Centre Eau Terre Environnement, Québec, 142 pages.

21 Genivar, Groupe AGÉCO and Jean-Thomas Bernard (2013). *Analyse avantages-coûts de la pertinence socio-économique de l'exploitation du gaz de schiste au Québec*, report submitted to the Bureau de coordination des évaluations environnementales stratégiques, Québec, 71 pages.

BOX 6

CONVENTIONAL AND UNCONVENTIONAL RESOURCES

Conventional oil and natural gas offer undeniable advantages. During extraction, oil or natural gas—often both of them—tend to migrate toward the vertical well and rise naturally to the surface, which makes them fairly inexpensive to exploit and requires relatively unsophisticated technologies to draw them to the surface.

On the other hand, unconventional resources are trapped inside rock reservoirs with limited permeability. To allow the migration of hydrocarbons toward the well, the industry must use sophisticated stimulation techniques aimed at increasing the porosity of the reservoir. Hydraulic fracturing seeks to crack subterranean rock. Sand and chemical additives keep the cracks open and avoid a proliferation of bacteria that would plug the equipment. When the techniques are poorly executed due to inadequate training or regulatory oversight, they can adversely affect the environment and public health through the contamination of groundwater and aquifers, one-off overexploitation of sources of freshwater, air pollution, noise pollution and low-amplitude seismic tremors, comparable to those felt when a heavy vehicle passes.

It should, however, be noted that the industry, which is aware of the challenges stemming from a negative perception of its activities, has achieved much better mastery of such techniques.

The Alberta oil sands are also unconventional resources but display characteristics unlike those of the tight reservoirs described above. The oil found there is in a viscous or semi-solid state and mixed with sand and clay. The techniques used do not seek to increase the speed of migration of hydrocarbons but simply to separate them from the sand to produce bitumin by means of hot water or very hot steam. That is why the exploitation of the oil sands requires significant amounts of energy. It offers a much lower energy efficiency ratio than conventional resource development. Once again, it should be noted that the techniques have been greatly improved over the past 20 years. Their carbon dioxide footprint has fallen by nearly 30% since.[22]

22 The Intergovernmental Panel on Climate Change (IPCC) regularly reassesses the global warming potential (GWP) of greenhouse gases. In its fifth and most recent report published in 2013, the GWP of methane over a period of 100 years was reassessed at 34 times the GWP of CO_2, which serves as a reference [climatechange2013.org/report].

Offshore, where drilling platforms must be built and underwater equipment installed to produce and transport resources, the regulation must seek to minimize all manner of hazards to avoid a spill. This concern is especially important when the well is located in a sensitive offshore zone but also hostile and cold such as the St. Lawrence estuary or the Gulf of St. Lawrence.

The threat of the loss of integrity of the well leading to discharges of fluids, including after the well is decommissioned, is often cited as a possible source of GHG emissions. Methane, whose greenhouse effect is 34 times greater than carbon dioxide, is the gas most likely to be released.[23] However, such emissions represent a very limited portion of total emissions during the useful life of a well.

Shale gas exploitation and exploration activities in the St. Lawrence Lowlands would thus increase Québec's annual GHG emissions. However, the estimates of this consequence vary considerably depending on whether a limited production scenario (1% increase in GHG emissions) or maximum production scenario (23% increase) is considered.[24] Furthermore, under the life cycle approach, Québec society is responsible for GHG emissions linked to the use of hydrocarbons from well to wheel. In this perspective, the replacement of emissions produced in supplier countries by emissions produced in Québec to ensure our energy supply does not alter planetary GHG emissions insofar as the rate of GHG emissions per unit of energy produced is more or less the same here as it is elsewhere.

Several shortcomings persist concerning the threats stemming from exploration, exploitation and decommissioning techniques and the maintenance of their integrity after decommissioning. Nevertheless, none of these threats is unique to the Québec context. Comparisons with other states or provinces where geological analogies are found might be beneficial and overcome the shortcomings.

The report entitled *Synthèse des connaissances et plan d'acquisition de connaissances additionnelles*, which the MERN made public on April 2, 2105 within the framework of the comprehensive SEA on hydrocarbons, provides a fairly exhaustive list of gaps in knowledge concerning risks, practices and techniques related to hydrocarbon exploration and exploitation. Additional studies to be carried out in the coming months will focus on a number of the shortcomings.

The findings of the comprehensive statement of operations of hydrocarbons, which is to be completed by the late fall of 2015, should offer a detailed look at the risks. Table A.1 in an appendix presents a detailed profile of the state of knowledge on risks associated with each region of Québec targeted for possible hydrocarbon production.

23 International Reference Centre for the Life Cycle of Products, Processes and Services (CIRAIG) (2014). *Revue de littérature sur les impacts environnementaux du développement des hydrocarbures au Québec*, Montréal, 188 pages.

24 Genivar, Groupe AGÉCO and Jean-Thomas Bernard (2013). *Analyse avantages-coûts de la pertinence socio-économique de l'exploitation du gaz de schiste au Québec*, report submitted to the Bureau de coordination des évaluations environnementales stratégiques, Québec, 71 pages.

ECONOMIC FACETS AND INVESTMENTS

The oil and gas industry encompasses companies of different sizes that may or may not be vertically integrated. Small entreprises usually resort to specialized service firms to carry out certain stages in the exploration or exploitation processes.

Exploration and exploitation activities usually occur over a long period and make it difficult to forecast possible production. This is especially true when data on existing, recoverable resources, the market price of the resource, the investments necessary for their exploitation and the environmental and public health risks incurred are incomplete.

In a context where prices appear to be fairly stable (near the current level for the next decade), it has not been established that shale gas production in the St. Lawrence Lowlands would be economically profitable for the companies involved.[25] The BAPE is also calling into question the overall profitability of extractive activities because of the scope of their possible repercussions on populations in addition to uncertainty surrounding the impact on water quality and the industry's ability to ensure the long-term leak-tightness of the wells.[26] In its December 2014 advisory opinion, the Régie de l'énergie reached a similar conclusion on Québec's natural gas supply by noting that there is no supply option in Québec's territory that can have a significant impact by 2030 on supply to satisfy demand for natural gas.[27] However, these general conclusions may no longer be valid if the price of natural gas rises. We must, therefore, ensure, that regulations are ready were the context to change.

As for oil, extraction trials were recently conducted in the Gaspé Peninsula (Galt IV). Were the economic potential to be demonstrated, the next step might be an application for an operating lease. This being the case, we must ascertain the impact that the recent drop in oil prices would have on exploration.

25 Bureau d'audiences publiques sur l'environnement (BAPE) (2014). *Les enjeux liés à l'exploration et l'exploitation du gaz de schiste dans le shale d'Utica des basses-terres du Saint-Laurent : Rapport d'enquête et d'audience publique* (Rapport 307), Québec, 523 pages.

26 Régie de l'Énergie (2014). *Avis sur les approvisionnements en fourniture et transport de gaz naturel nécessaires pour répondre aux besoins en gaz naturel des consommateurs québécois à moyen et long terme*, Québec, 84 pages.

27 Patrick Gonzalez, Sarah Trabelsi and Sophie Jacques-Barma (2015). *Bilan des connaissances de l'économie des hydrocarbures au Québec*, Université Laval, Centre de Recherche en économie de l'Environnement, de l'Agroalimentaire, des Transports et de l'Énergie (CREATE), Québec, 82 pages.

REGULATION AND GOVERNANCE

The harmonious development of a hydrocarbon industry in Québec must inevitably be conditional on the elaboration and modernization of the applicable legislative and regulatory framework and the clear definition of the government's role and its policy directions respecting this energy option. This is the objective of the new integrated legislation on hydrocarbons, which the Québec government expects to adopt in 2016. The adoption of such a set legal framework that is stable over time will also be beneficial from the standpoint of social acceptability and investment.

Legal oversight of offshore natural resource exploitation is an area of jurisdiction that two levels of government share. One challenge is to harmonize measures pertaining to environmental protection, environmental impact assessments, the transportation of hazardous materials, labour, health and public safety, among other things. In 2011, the federal and provincial governments reached agreement on the joint management of hydrocarbons in the Gulf of St. Lawrence. They will shortly submit the same harmonized statutes to carry out the agreement and structure in a concerted, coherent manner the activities in question.

When the new legislative framework is elaborated, the Québec government will be able to rely on the findings of the strategic environmental assessments that it has requested and on the reports of the BAPE devoted to hydrocarbons.

Table 6.3
List of the strategic environmental assessments and investigation and public hearing mandates attributed to the BAPE devoted to hydrocarbons

Studies and investigations	Date of release
Mandate of the BAPE concerning the sustainable development of the shale gas industry in Québec	Report published in 2011
SEA1 devoted to offshore hydrocarbon development	Halting of SEA1 and adoption of the *Act to limit oil and gas activities* in June 2011
SEA2 devoted to offshore hydrocarbon development	Studies published in 2013
Public consultation within the framework of the offshore SEA2	Report published in 2013
Mandate of the BAPE on the impact of natural resource exploration and exploitation on water tables in the Îles-de-la-Madeleine, especially those linked to gas exploration and exploitation	Report published in 2013
SEA on shale gas	Studies published in 2014
Mandate of the BAPE on challenges stemming from shale gas exploration and exploitation in the Utica Shale in the St. Lawrence Lowlands	Report published in 2014
Specific SEA on hydrocarbon exploitation on Anticosti	Under way (final report expected in late 2015)
Comprehensive SEA on hydrocarbons	Under way (final report expected in late 2015)

Note: The SEA reports are available on the website of the *Government Action Plan on Hydrocarbons* [hydrocarbures.gouv.qc.ca/evaluations-environnementales-strategiques.asp], and the investigation and public hearing reports of the BAPE are available on its website [bape.gouv.qc.ca/].

The legislative and regulatory framework of hydrocarbon exploration and exploitation activities should benefit from the experience of the provinces and American states where such activities have occurred for a long time. It should also reflect the choices made with respect to the type of royalty regime and taxation system, the Québec government's precise role in such developments, and the benefits for Québec society stemming from such activities. The royalty regime governing onshore hydrocarbon exploitation in Québec should take into account the communities that occupy the territory.

The Québec government's participation in the development of a Québec hydrocarbon production industry should be evaluated in light of its current and previous experience in the development of energy and mining sectors (hydroelectricity, wind power, hydrocarbons, mines) bearing in mind the specific nature of the oil and natural gas options. Such participation should take into account the limited degree of expertise developed in Québec and the high level of risk that the industry is facing. The government must ascertain the anticipated economic benefits of an appropriate tax and royalty system and the desired benefits of direct government participation in the operations. In the same way, as for the attribution and management of oil rights, the government might opt for a negotiated approach with businesses or an administrative approach or an auction.[28]

28 SNC Lavalin (2013). *Projet d'usine de fabrication d'engrais*. Environmental impact statement submitted to the Minister of Sustainable Development, Environment, Wildlife and Parks. Projet de production d'engrais d'IFFCO Canada, Bécancour, 399 pages.

SECTION 7

THE SOCIAL CONTRIBUTION OF HYDROCARBONS

Oil and natural gas play a fairly important role in the economy. Oil and petroleum products play a vital role in economic activity but also in the daily lives of individuals. Aside from their energy uses that account for roughly 90% of demand, the attendant social benefits concern public health (food packaging, hygiene, cleanliness), individual comfort (all useful objects), lighter vehicles (reduced consumption and GHG emissions), and medicine (care, microtubular apparatus, and so on), among other things.

The prosperity of societies and the longevity of individuals are partly attributable to the use of such products that have very valuable physical and chemical properties. They make life easier and satisfy numerous everyday needs.

A BRIEF HISTORY

The oldest texts of written culture attest the use of oil. However, it is indirectly the development of the oil lamp in the late 18th century that contributed several decades later to oil's popularity. We now recognize that the oil lamp saved whales threatened by extinction because of intensive hunting to obtain the oil necessary for lighting. In the late 19th century, the development of gasoline and diesel engines meant that demand for oil gradually equalled then surpassed demand for coal as the world's leading energy source.

The advent of motor vehicles facilitated the movement of passengers and freight and enhanced the quality of life of individuals. For example, tractors reduced farmers' efforts in respect of agricultural work and harvesting. Motorized mechanical equipment also rendered similar services by reducing arduous human physical effort such as excavation, deforestation, and so on. Oil gradually replaced horses. It was a source of economic and social progress that benefited individuals.

NON-ENERGY PRODUCTS DERIVED FROM OIL REFINING

Aside from transportation, heating and cooking, oil is also used to manufacture widely used, even essential, non-energy products.

For example, hydrogen is derived from certain oil refining processes. It is used to desulphurize petroleum fractions containing sulphur in order to reduce SO_2 emissions, which are partly responsible for acid rain and which used to disturb forests and lakes. This operation also improves the longevity of motor vehicle catalytic converters.

Moreover, the sulphur extracted from oil is used to produce agricultural fertilizer. The urea used to manufacture agricultural fertilizer is synthesized from natural gas. Fertilizers partly derived from hydrocarbons now ensure food security the world over. According to the Canadian Fertilizer Institute, fertilizers increase the yield of Canadian farmland by roughly 40%.[29]

The processing of oil makes available numerous components used to manufacture products such as grease removers, cleaning fluids, household cleaning products, phytosanitary products used in agriculture, antifreeze and coolants, and so on. Solvents derived from oil are used in particular for dry cleaning, oil work, the manufacture of rubber, the preparation of rubber-based glues, the extraction of fat, the manufacture of tallow, the dehydration of alcohol and the extraction of perfumes.[30]

The gas-oil fractions of oil are used to produce grease and lubricating oil, paraffin and other related products. When the inorganic bases of lubricating oils are manufactured, wax and paraffin are extracted. Certain paraffins are used in the food industry to impregnate paper and packing boxes. They are also used to manufacture candles, beauty products and waxes.

We must also rely on the bituminous fractions of oil to satisfy numerous needs that enhance the quality of life, such as asphalt road paving, which eliminates dust and ensures driving that is more comfortable, safer and more eco-efficient.

Bitumins are also used to produce numerous tars and other caulking, sealing, soundproofing (buildings, automobiles, household appliances), electrical insulation (electric cables, condensers, electric batteries or storage batteries). What is more, tars are used to manufacture roofing shingles and to seal concrete walls.

Lastly, petroleum coke derived from residual fractions of oil is used, inparticular , to manufacture the anodes used to produce aluminium.

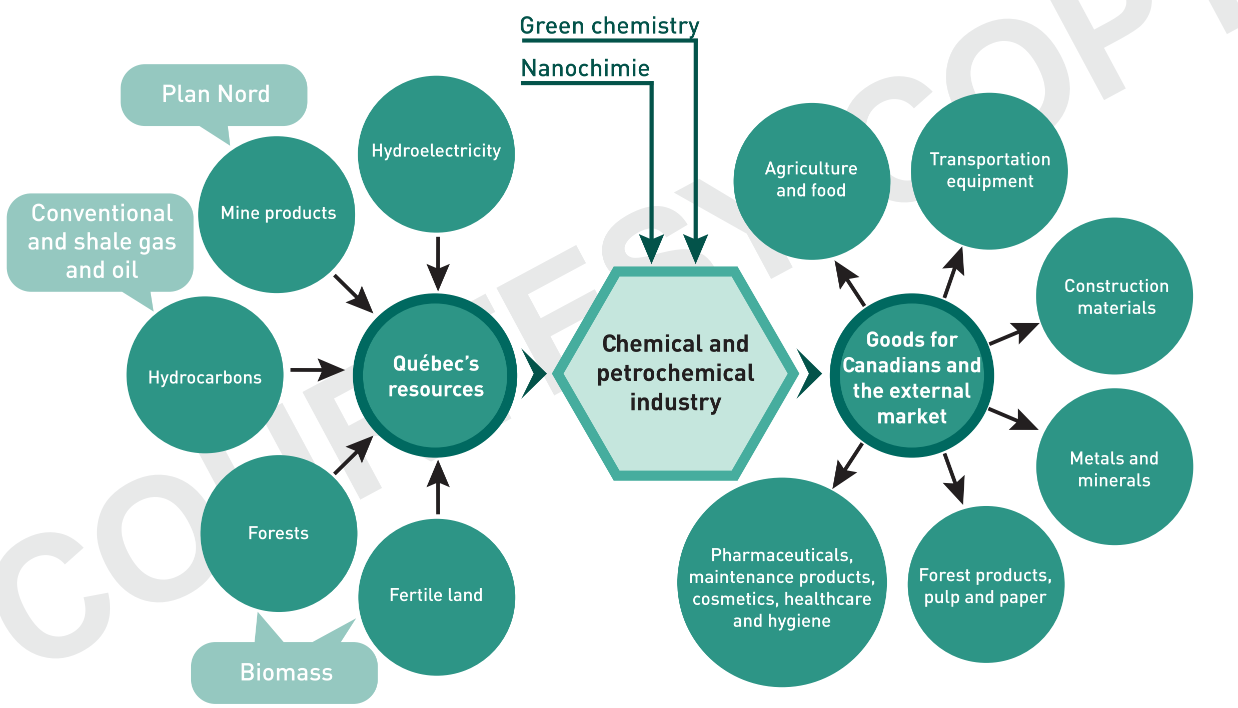
29 Jean-Pierre Wauquier (1994). *Le raffinage du pétrole - Tome 1 - Pétrole brut, produits pétroliers et schémas de fabrication*, Institut français de pétrole, Éditions Technip, 510 pages.

30 Comité sectoriel de main-d'œuvre des plastiques et composites (2012). *Mini-brochure - Promotion des carrières* [online] [plasticompetences.ca/wp-content/uploads/2012/03/mini_brochure_promotion_carrieres1.pdf] (consulted on May 4, 2015).

PETROCHEMICAL PRODUCTS

Petrochemical products, an application of industrial chemistry that makes it possible to convert molecules from hydrocarbons into everyday products, are found in a wide range of applications, in particular coverings, packaging, vehicles, aircraft and textiles. Figure 7.1 illustrates all of the sub-sectors that use chemical and petrochemical products and their relationship with the resources available in Québec.

Figure 7.1
Manufacturing sectors associated with petroleum products



Source: Chemistry Industry Association of Canada.

PLASTICS

Plastics, which are manufactured using light molecules derived from oil, are constantly enhancing quality of life. They can be moulded in different shapes and a wide range of colours to enhance the appearance of objects. The popularity of plastic is attributable to its low cost, solidity, lightness, recyclability and imputrescibility.[31] In the automotive industry, the reduction of vehicle weight that plastics allow affects fuel consumption.

Plastic packaging helps maintain public health and considerably extend the quality of certain foods, especially meat. In the medical sector, plastic tubes, valves and joints are considerably enhancing Quebecers' quality of life.

Plastics are readily recyclable and are also highly efficient raw materials from the standpoint of resources, energy and GHG emissions in relation to raw materials such as metal or wood.

The polymers used to manufacture insulating foam such as polystyrene and polyurethane achieve a high degree of thermal insulation in residential and commercial buildings. Their contribution to energy efficiency is undeniable. Their low weight and affordable cost are an advantage. The attendant reduction in heating needs contributes to limiting GHG emissions.

THERMOSETTING RESINS

Thermosetting resins are obtained by polymerization, usually under the effect of heat, which is irreversible and forms a solid finished product that cannot be recycled, is infusible and non-transformable.[32] The resins are found everywhere in our environment, especially in construction materials. Urea-formaldehyde, polyester, epoxide and phenolic resins are the most commonly used.

Polyester and epoxide resins are used mainly in the composites sector combined with fibreglass or carbon fibre. Various parts are manufactured with the resins, such as components in the ground transport sector (trucks, trains, cars), the aeronautics sector, wind power (rotor blades, nacelles) or construction materials. The considerable mechanical strength of composite materials in relation to their low weight make their use unavoidable in several applications.

31 Batiproduits.com (2015). *Résine thermodurcissable* [online] [batiproduits.com/batiwiki/Resine-Thermodurcissable/definition?guid= AD0EBD99-F86B-4ED8-BDBB-F911B4411F2A] (consulted on May 5, 2015).

32 Alice Roux (2013). *L'huile minérale dans les cosmétiques : la pétro-chimie incarnée…* [online] [blog.denovo-beaute.com/lhuile-minerale-dans-les-cosmetiques-la-petro-chimie-incarnee/] (consulted on May 4, 2015).

Phenolic and urea-formaldehyde resins are mainly used in composite materials that contain wood fibre. Chipboard such as particleboard, medium density fibreboard or plywood are widely used in furniture manufacturing and home construction. Wood particles can be recycled into highly useful materials using oil-based resins.

COSMETICS AND BEAUTY PRODUCTS

Mineral oil, which is a highly waterproofing greasy substance derived from hydrocarbons, is a widely used ingredient in the cosmetic industry, where it acts as an emollient (to soften the skin) and an occlusive agent (to prevent drying). It is found in products for the body, sunscreen, babies and make-up, in particular salves and lipstick, make-up bases, foundation, powders and rouge, hair products and most pharmaceutical skin preparations. It is the main ingredient in a number of products.[33]

33 Ministère de l'Énergie et des Ressources naturelles, preliminary estimate based on partial data and preceding years.

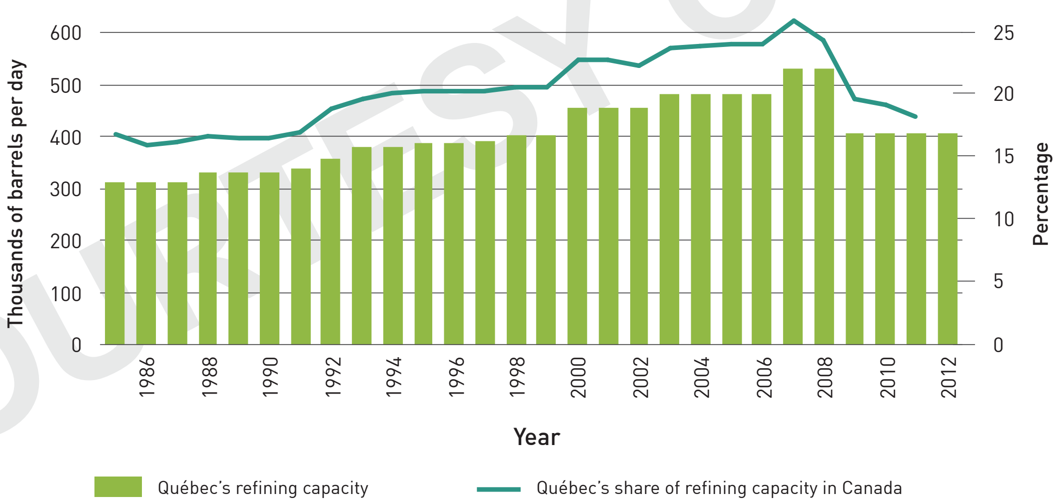
ECONOMIC DEVELOPMENT

The energy sector accounts for nearly 5% of Québec's gross domestic product (GDP) and is contributing to the vitality of a number of areas of activity. Energy supply, transportation and distribution in all regions of Québec are thus sustaining employment and economic development.

QUÉBEC'S TRADE BALANCE

The crude oil that Québec imports is converted into refined products at the Suncor refinery in Montréal and the Valero refinery in Lévis, which have a combined refining capacity of 402 000 barrels per day.

Figure 8.1
Change in Québec's refining capacity and its share of refining capacity in Canada (1985-2012)



Sources: Ministère de l'Énergie et des Ressources naturelles and Statistics Canada.

Two Québec refineries export significant amounts of gasoline and diesel fuel to Ontario and elsewhere in addition to other products, since the refinery output exceeds local demand by roughly 1.5 million ton oil equivalents (toe) per year. While Québec imports all of the oil refined in its territory, it is a net exporter of refined products. Such exports totalled $8 billion in 2012. This economic activity thus partially offsets the impact of crude hydrocarbon purchases from Canada and abroad, which in 2014 cost nearly $14 billion in the case of oil and roughly $1.3 billion as regards natural gas.[34, 35]

VALUE CHAIN OF FOSSIL HYDROCARBONS

Several areas of activity in Québec depend on reliable, diversified, competitively priced energy supplies to ensure their competitiveness and survival. This is true, in particular, of the mining industry, the digital technologies and primary metal manufacturing. Energy can account for 4% of production costs in the mechanical equipment manufacturing sector and up to two-thirds of production costs in the manufacture of chemical products.[36]

The pivotal role of energy as an input in several industries makes supply crucial. Oil and natural gas, which are more readily transportable outside the main distribution channels, are worthwhile options for regions where access by electrical transmission and distribution networks is difficult. LNG, by way of an example, offers the most eco-efficient energy solution in this context.

Petroleum products are also a key input in the Québec petrochemical sector, which is concentrated above all in Montréal-Est, where the proximity of the Suncor refinery and Énergie Valero's storage facilities allow for some degree of integration in addition to facilitating deliveries and shipments through the Port of Montréal. The Montréal-Est terminal is the biggest terminal in Canada. This strategic infrastructure represents a hub for the Canadian petrochemical industry.

This geographic concentration also allows for collaboration with the Montréal-Est industrial cluster. A number of these firms thus depend on each other. For example, Selenis Canada is the only company in Canada that manufactures polyethylene terephthalate (PET), a plastic used, for example, in recyclable bottles. It thus directly depends on the production chain formed by Suncor, Chimie Parachem and Cepsa Chimie, all of which are located in the same region.[37]

34 Ministère de l'Énergie et des Ressources naturelles, preliminary estimate based on partial data and preceding years.

35 Ministère de l'Énergie et des Ressources naturelles (MERN) (2014). *Profil statistique de l'énergie au Québec* [online] [efficaciteenergetique.gouv.qc.ca/fileadmin/medias/pdf/fasicule-2.pdf] (consulted on May 1, 2015).

36 Gouvernement du Québec (2013). *Inversion du flux de l'oléoduc 9B d'Enbridge, consultation publique,* Québec, 63 pages.

37 Patrick Gonzalez, Sarah Trabelsi and Sophie Jacques-Barma (2015). *Bilan des connaissances de l'économie des hydrocarbures au Québec*, Université Laval, Centre de Recherche en économie de l'Environnement, de l'Agroalimentaire, des Transports et de l'Énergie (CREATE), Québec, 82 pages.

Québec also has the most manufacturers of asphalting products, asphalt roofing and asphalt saturated materials in the country.[38] The expertise that the refining and petrochemical industry has developed is also promoting the biofuels industry.[39]

REPERCUSSIONS ON EMPLOYMENT

The oil industry employs just over 51 000 people, mainly in the automobile fuel distribution sector, and contributes $8.8 billion to the province's GDP.[40] Suncor's Montréal refinery employs roughly 400 workers and pays more than $55 million in corporate taxes to the provincial and federal governments.[41] The Valero refinery, located in Lévis, employs roughly 500 workers and also pays taxes to governments. The Suncor and Valero refineries in Québec account for an estimated 6 500 indirect jobs.

The proposed expansion by Gaz Métro of the LNG plant in Montréal and the construction by Stolt LNGaz inc. of a plant in Bécancour will help to create additional jobs in the coming years.

The Québec petrochemical sector comprises roughly 625 companies, supports nearly 15 000 direct jobs and contributed $8.5 billion to Québec's GDP in 2012. However, the sector's trade balance displays a structural deficit of $2 billion, mainly with the United States.[42]

Mention should also be made of the possible economic spinoff from the Energy East Pipeline project, described in section 5. One of the conditions that the Québec government imposed prior to the examination of the project was that it generate economic spinoff in the short and medium terms, in particular as regards job creation. According to an evaluation of such spinoff during the project's development phase (seven years), Québec would benefit from 27.8% of the cumulative effects of the $4.6 billion of GDP that the project generates, and from 29.3% of the jobs (128 337 person-years). According to the Conference Board of Canada, during the first 20 years of operation, Canada should collect a minimum of $4.7 billion in tax revenues.[43] Assuming that the federal revenues are distributed according to the demographic profile, Québec could count on roughly 23% of this amount. However, these figures are tentative as the final version of the project has not yet been submitted.

38 Background Document 4, Renewable Energies, available on the energy policy website [politiqueenergetique.gouv.qc.ca/documentation], presents more detailed information on biofuels.

39 Gouvernement du Québec (2013). *Inversion du flux de l'oléoduc 9B d'Enbridge,* consultation publique, Québec, 63 pages.

40 Marc Van Audenrode, Lisa Pinheiro and Anne Catherine Faye (2013). *Analyse de l'impact économique de la raffinerie Suncor de Montréal sur la ville de Montréal et le Québec*, Montréal, 35 pages.

41 Gouvernement du Québec (2013). *Inversion du flux de l'oléoduc 9B d'Enbridge,* consultation publique, Québec, 63 pages.

42 Conference Board of Canada (2014). *Projet d'oléoduc Énergie Est : les retombées économiques pour le Canada et ses régions* [online] [oleoducenergieest.com/wp-content/uploads/2014/10/Le-Conference-Board-Du-Canada-Rapport-Personnailise.pdf] (consulted on May 4, 2015).

43 Ministère de l'Énergie et des Ressources naturelles (MERN) (2014). *Crédit d'impôt relatif aux ressources* (Revenu Québec) (Loi sur les impôts – Agence du revenu du Québec) [online] [mern.gouv.qc.ca/publications/mines/fiscalite/credit-impot.pdf] (consulted on May 5, 2015).

As for the natural gas sector, it should be noted that Gaz Métro, a distributor, employs roughly 1 400 people in Québec. Natural gas is also a vital option as regards employment in the regions, since it is a key factor in the location of businesses. Adequate energy supplies at reasonable cost in the regions located in the territory that the Northern Plan covers, among other things, are essential to ensure the profitability of several industrial projects. The establishment of facilities to distribute LNG at less cost than the extension of the gas pipeline network might also lead to job creation.

To these sectors might be added a local hydrocarbon exploitation industry. However, it is too early to estimate the exact number of jobs that might be created in the sector.

TAXATION, ROYALTIES AND EQUITY PARTICIPATION

Hydrocarbon production might offer Québec several benefits through the royalties and taxes that the companies pay, profits stemming from equity participation, jobs created or the revenues that the government collects for the permits issued. These potential benefits are affected by possible negative externalities such as environmental degradation, public health risks, drawbacks for residents, or additional GHG emissions.

To support risk-taking by investors, Québec offers a refundable tax credit for natural resources[44] that ranges from 12% to 31%. In the case of a small exploration company with no income, the Québec government thus finances just under one-third of its expenses.[45]

Québec has already established a series of measures respecting mining royalties, such as the Generations Fund, which is used to reduce public debt.

A wide array of tax rates and royalties applicable to hydrocarbon production exists in the world and each regime has its own specific traits. Were Québec to undertake such production, the royalty regime and the taxation to be established should be flexible and adapted to conditions in Québec, while guaranteeing to potential investors the stability over time of the legal and regulatory framework.

As for natural gas, the government proposed in *Budget 2011-2012* to replace the existing fixed-rate royalty regime by a new regime based on resource prices and the average daily volume of production.

44 Patrick Gonzalez, Sarah Trabelsi and Sophie Jacques-Barma (2015). *Bilan des connaissances de l'économie des hydrocarbures au Québec*, Université Laval, Centre de Recherche en économie de l'Environnement, de l'Agroalimentaire, des Transports et de l'Énergie (CREATE), Québec, 82 pages.

45 Robert K. Perrons (2014). "How innovation and R&D happen in the upstream oil & gas industry: Insights from a global survey", *Journal of Petroleum Science and Engineering*, 124: 301-12.

Table 8.1
Proposed royalty rates for natural gas production, according to market price and production volume

Production scenario	Limited			Average		High	
Average daily volume (in 1 000 m^3)	250	750	1 250	1 750	2 250	2 750	3 500
Price ($/barrel)*	Applicable royalty rate (%)						
$4	5.0	6.1	13.0	19.8	26.6	30.0	30.0
$5	5.0	11.1	18.0	24.8	31.6	35.0	35.0
$6	9.2	16.1	23.0	29.8	35.0	35.0	35.0
$7	11.7	18.6	25.5	32.3	35.0	35.0	35.0
$8	14.2	21.1	28.0	34.8	35.0	35.0	35.0
$9	16.7	23.6	30.5	35.0	35.0	35.0	35.0
$10	19.2	26.1	33.0	35.0	35.0	35.0	35.0

* The price that will be used to establish the royalty rate will take into account the current price, the cost of transportation, the cost of processing the gas, and so on. The legal and regulatory framework will specify the terms and conditions.
Source: Ministère des Finances.

Furthermore, *Budget 2011-2012* tabled on March 20, 2012 also proposed modifications to the royalty regime applicable to onshore oil, which would then depend on the average daily volume of production and the price of oil.

Table 8.2
Proposed royalty rates for onshore oil production according to price and production volume

Production scenario	Limited			Average		High	
Average daily volume (in barrels)	25	50	75	200	300	600	800
Price ($/barrel)*	Applicable royalty rate (%)						
$50	5.0	5.0	10.0	21.3	25.8	31.8	35.0
$75	8.3	13.3	18.3	29.6	34.1	40.0	40.0
$100	16.7	21.7	26.7	37.9	40.0	40.0	40.0
$125	25.0	30.0	35.0	40.0	40.0	40.0	40.0
$150	25.0	30.0	35.0	40.0	40.0	40.0	40.0

* The price that will be used to establish the royalty rate will take into account the current price, the cost of transportation, the cost of processing the gas, and so on. The legal and regulatory framework will specify the terms and conditions.
Source: Ministère des Finances.

The royalty regimes applicable to natural gas and oil production have not been adopted.

As for government participation in the exploitation of oil and natural gas resources, it should be noted that these activities require very high capitalization. This complicates the prospect for significant or even majority participation by the government through a government corporation similar to Hydro-Québec, such as Statoil in Norway. Québec must carefully assess its options. It may prove to be more judicious to opt for more modest equity participations according to the assessment of risk and potential profit specific to each project. Be that as it may, government participation must occur in such a way to maximize economic spinoff and minimize risks for Québec within the framework that it establishes.

BOX 7

THE CAPITAL MINES HYDROCARBURES FUND

The Québec government intends to establish the Capital Mines Hydrocarbures (CMH) fund, a special fund designed to put to work and increase the funds allocated to it mainly to acquire equity participations in enterprises that mine mineral substances in the Québec public domain and the companies that process them. This initiative seeks to broaden the development of the mining and hydrocarbons sectors, which generate significant economic spinoff that benefits both Québec's regions and all of its economic sectors.

The fund's establishment will reaffirm the government's determination to encourage the responsible development and processing of mineral substances to enable Québec society to benefit directly as a shareholder from the profits of the companies concerned.

The fund's minority interests will be obtained under conditions that are at least equivalent to those available to other investors. Equity investment projects in businesses will be conducted on a business basis according to a responsible investment approach.

Moreover, the CMH will support the revival of the Northern Plan by providing an additional source of funding to carry out private investment projects. Management of the fund will be assigned to Ressources Québec, a subsidiary of Investissement Québec, which is fulfilling its mandate in close collaboration with the Ministère de l'Économie, de l'Innovation et des Exportations, the Ministère de l'Énergie et des Ressources naturelles and the Ministère des Finances.

Ressources Québec

Ressources Québec will guide businesses throughout the realization of their projects, from exploration to exploitation to natural resource processing. It offers an array of financial products such as equity interests in the share capital of companies, debentures and loans.

Ressources Québec makes up private financing by promoting projects that offer potential for promising returns and are structuring for the Québec economy.

It will also manage the CMH fund, which will have $1-billion budget and be devoted to Québec government investments in non-renewable natural resources.

Ressources Québec has a mandate with respect to the hydrocarbons sector to:

- develop the relevant know-how and thus be in a position to analyze the financial risks of gas and oil projects;
- promote the emergence of a services industry;
- suggest equity participations to the government in respect of projects with worthwhile investment potential. Equity participations are conducted by mutual agreement.

To obtain additional information, please visit the Ressources Québec website (www.investquebec.com/quebec/fr/a-propos-de-nous/nos-filiales/ressources-quebec.html).

SECTION 9

INNOVATION IN THE PRODUCTION SECTOR

Innovation in the oil and gas sectors usually stems from research conducted by large businesses with considerable resources. More recently, service firms whose investments in research and development have no impact on the short-term results of large businesses, which are their clients, have also engaged in innovation. According to a study published in the *Journal of Petroleum Science and Engineering,*[46] the business units of such companies have played a decisive role in more than 80% of the new technologies used. Among such technologies, 782 came from service firms and 227 from oil multinationals.

However, large businesses are usually financially and psychologically cautious organizations. Consequently, they achieve greater success in terms of ongoing innovation and less so from the standpoint of radical innovation. While regulatory requirements undoubtedly affect innovation, the key mainsprings of radical innovation are receptiveness to new ideas, experimentation and risk-taking, which do not correspond to the cautious traits that characterize such firms. The worldwide oil and gas industry spends less than 0.5% of its revenues on research and development, which ranks it last among area of activity in this respect.

46 PwC (2013). *Gateway to growth: innovation in the oil and gas industry* [online] [pwc.com/en_GX/gx/oil-gas-energy/publications/pdfs/pwc-gateway-to-growth-innovation-in-the-oil-and-gas-industry.pdf] (consulted on April 28, 2015).

BOX 8

OPEN AND CLOSED INNOVATION

According to Roland Berger (2014), a European consulting firm in the realm of strategy, Apple and Google epitomize rapid innovation. Apple has adopted the closed innovation approach. The company is introverted, opaque and perfectionist. It maintains control from start to finish over the development of its products. On the other hand, Google is an open, almost anarchic company, that moves quickly. It launches its products when they are in various stages of development, relying on crowdsourcing to engage in product-related decision-making. It is willing to modify its products as the process proceeds.

Berger claims that the current approach in the oil industry is similar to the closed approach, while the industry should consider an open approach in order to make radical breakthroughs. Despite Apple's success, the closed approach is used to maximize efficiency, profitability and the growth of the outcome. On the other hand, the open approach makes it possible to more readily achieve rapid growth in sales and the development of more innovative products and processes.[47]

The shale gas revolution, the precursor of the tight oil revolution, was launched by Mitchell Energy, a relatively small Texas oil and gas producer. During the 1980s and 1990s, George Mitchell's company perfected hydraulic fracturing of gas in the Barnett Shale by adopting and adapting new technologies and methods from the research laboratories of the US Department of Energy.

Royal Dutch Shell's GameChanger program is often cited as an example of a big multinational that has successfully carried out radical innovations. Shell adopted the program during a period of cost-cutting and an industry slowdown in the mid-1990s. It based its model on the Silicon Valley ecosystem and incorporated elements of open innovation, firms that act as incubators, and intercompany cooperation. In 2002, Shell established research partnerships with leading universities in Europe and the United States. Some 300 of the partnerships have led to commercial projects that reduce costs, enhance environmental performance and create new resources for development.[48]

Were Québec to establish an oil and gas production industry, China's recent attempts to develop its shale gas reserves could be revealing. The gas and oil industry is characterized by an abrupt learning curve, given its high technological component. Chinese state oil companies have established partnerships to contend with the learning curve. Since 2010, PetroChina has cooperated with Shell on several activities and has acquired a percentage of the shares in one of the multinational's projects concerning Canadian shale gas. The China National Petroleum

47 John Mitchell (2012). *What Next for the Oil and Gas Industry?* [online] [www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/1012pr_oilgas.pdf] (consulted on April 29, 2015)

48 Platts (2014). *China cuts 2020 shale gas output target as challenges persist* [online] [www.platts.com/latest-news/natural-gas/singapore/china-cuts-2020-shale-gas-output-target-as-challenges-27641138] (consulted on May 4, 2015).

Corporation (CNPC) signed a production sharing agreement with Shell in 2012 covering the search for shale gas in China.[49] The China National Offshore Oil Corporation (CNOOC) purchased Nexen, an independent Canadian producer the following year, partly to gain access to technologies that would enable it develop shale gas in China.

Despite such efforts to obtain expertise and technology from Western businesses, China, the next likely shale gas superpower, is experiencing difficulties. In September 2104, the Chinese government had to reduce its shale gas production forecasts because of the limited progress achieved until now. China is now seeking to produce 30 billion m^3 by 2020, well below the previous informal target of 60 to 100 billion m^3.[50] Not all shale deposits are alike and each one requires significant technological development to achieve profitable exploitation.

From the standpoint of innovation, it remains to be seen whether a possible Québec oil and gas industry would rely on the so-called "open" model. Given its small size, it should emphasize certain technological niches. For example, such an industry would benefit from concentrating on shale gas and oil extraction technologies and, in particular, those with the greatest potential to reduce costs and enhance environmental security and performance. University chairs and private research initiatives could greatly contribute to progress in the field. The government can influence such choices by elaborating a development framework that promotes this innovation model and by supporting research.

49 John Mitchell (2012). *What Next for the Oil and Gas Industry?* [online] [www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/1012pr_oilgas.pdf] (consulted on April 29, 2015)

50 Platts (2014). *China cuts 2020 shale gas output target as challenges persist* [online] [www.platts.com/latest-news/natural-gas/singapore/china-cuts-2020-shale-gas-output-target-as-challenges-27641138] (consulted on May 4, 2015).

SECTION 10

CHALLENGES AND QUESTIONS

GENERAL CHALLENGES

The development and use of fossil hydrocarbons pose specific technological, societal, economic and logistical challenges. The nature and scope of such challenges can vary in the case of oil or natural gas. The challenges are covered by an energy policy that must strike a balance between the desired contribution of each energy source, its use in the right place and the broader context applicable to Québec.

The reconciliation of uses in Québec with an unknown new area of activity poses a challenge.

Abundance prevails because of significant unconventional gas and oil deposits exploited in the United States (oil and shale gas) and in Canada in the North American energy environment in which Québec is developing.

Such abundance has a genuine impact on the level of prices, the effort expended in the search for greater energy efficiency and the importance attached to GHG emission reduction targets. Oil and natural gas production in Québec also poses the broader challenge of increased GHG emissions.

While risks related to public safety, individual health, social cohesion in host communities, public finances and environmental protection may seem greater in the case of hydrocarbons than for other forms of energy such as hydropower or biofuel-based electricity generation, they are not exclusive to these forms of energy. Risk management poses a challenge for most energy projects the world over. The opportunity study of projects related to fossil hydrocarbons must also be established by comparing their benefits and anticipated consequences with other comparable options using other forms of energy that satisfy the same need.

One challenge facing Québec is to strike a balance between the consumption and production of different forms of energy, which assumes that we first determine the place that hydrocarbons should occupy in a context where we know that they will not disappear in either the short term nor the medium term.

Québec's unfavourable trade balance stems largely from hydrocarbon imports.

The challenges that the oil and natural gas option pose also reveals the importance of determining the measures to be adopted to maintain public confidence both in the government as a credible arbitrator and in the other interveners involved.

QUESTIONS

- How can the Québec government strike a balance in the measures that it is implementing between the different energy options?
- How can Québec balance the use of hydrocarbons and that of other forms of energy in order to obtain its objectives in respect of GHG reduction, sustainable development and economic development in a spirit of respect for the public's tolerance of stricter regulation and user fees that more broadly reflect the negative externalities of carbon?
- What priority should be given to regulatory measures in relation to voluntary mesures or incentives in oversight of the activities of the oil and natural gas options?
- In its forthcoming energy policy, should Québec set precise targets concerning the share that each form of energy should occupy in its energy balance at the conclusion of the 10-year period?
- What would be the advantages, as the case may be, of broadening the mandates of the public research centres assigned to the generation, transmission or use of electricity to the natural gas and oil options or of assembling them in the same research consortium?
- Should we broaden the responsibilities of the Régie de l'énergie in a manner similar to those of the Ontario Energy Commission so that the Régie conducts consultations focusing on the entire array of agricultural, social, economic and environmental dimensions of energy projects put forward in Québec?
- How must we review the Régie de l'énergie's energy project evaluation practices to adapt them to new societal and technological conditions?

CHALLENGES RELATED TO THE CONSUMPTION OF HYDROCARBONS

Québec's consumption of hydrocarbons is characterized by very high dependence on oil in the transportation sector, reduced but not insignificant use of fuel oil for domestic heating and in industry, and the important role of natural gas in the commercial and industrial sectors.

In the transportation sector, the replacement of oil by other types of "fuels" deemed to be cleaner from an environmental standpoint poses a challenge bearing in mind, in particular, current low oil prices, the establishment of adequate infrastructure and the compromises that users must make.

Liquefied or compressed natural gas (CNG) offers environmental advantages when compared with the petroleum products that it can partly replace in certain markets for transportation, heating or industrial processes. The consumption in Québec of hydrocarbons must be understood in the context where non-energy products such as asphalt or plastic account for roughly 7% of total hydrocarbon consumption (downstream industry).

QUESTIONS

- To what extent and at what pace should Québec reduce its oil consumption and what criteria should it adopt to establish these objectives?
- What are realistic rates of replacement by 2030 and 2040 of petroleum products by natural gas and propane in different economic sectors, including the transportation sector?
- How can the harmonized, safe implementation of oil processing (refinery) and natural gas (liquefaction) processing be planned from the standpoint of the needs of the domestic, Canadian and international markets?

CHALLENGES RELATED TO THE TRANSPORTATION OF HYDROCARBONS

Québec's oil and natural gas supplies will continue for a number of years to come from beyond its borders. These energy products reach Québec by pipeline, train or ship.

Considering recent changes in Canadian and foreign oil prices, in North Sea Brent crude oil, oil supplies from other sources are increasingly emphasized, e.g. Western Canada and the Midwestern United States, which explains the proposed reversal of Enbridge's 9B pipeline and TransCanada's proposed construction of the Energy East Pipeline. The two projects are raising questions and concerns among individuals and various interveners.

From a strictly supply perspective, the realization of the two projects would ensure the reliability of transportation and supply necessary to satisfy Québec's short- and medium-term oil needs. Considering public sensitivity to the transportation of oil and petroleum products, questions related to the safety of individuals and property are crucial in the comparative analysis of any project to supply hydrocarbons to Québec.

Québec's considerable geographic size, its access to the St. Lawrence River and the Atlantic Ocean, and the current state of rail infrastructure and oil and gas pipelines are all risk factors. It goes without saying that an appropriate regulatory framework for different means of transportation, including the ability of public authorities to ensure follow-up and control and to react rapidly in the event of an incident or accident, essentially requires close collaboration between the different levels of government and with the oil and gas industry. The assessment of the risk and the potential economic spinoff from transportation infrastructure requires a window of at least 10 years.

The challenges are thus numerous concerning the transportation sector, including Québec's ability to diversify its sources of supply in order to benefit economically from the new energy situation in North America and to ensure diversified energy supply in all regions, including the remotest ones. Indeed, supplying regions not served by electrical distribution networks or gas pipelines is a key factor in the economic development and profitability of industrial projects such as those located in the territory that the Northern Plan covers.

Liquefied natural gas might represent a worthwhile option for such regions and the economic viability of certain projects that engender direct or indirect jobs.

QUESTIONS

- Which modes of transportation should be emphasized in respect of oil and natural gas produced in Québec and imported? Why?
- Is it desirable to add oil and gas transportation infrastructure in Québec given its needs and the socioeconomic benefits that it can derive from the exploitation of such infrastructure in its territory?
- Under what environmental, economic or other conditions would oil and natural gas pipeline projects be acceptable for Québec and how can we ensure that such conditions are in fact met?

CHALLENGES RELATED TO HYDROCARBON PRODUCTION IN QUÉBEC

Knowledge of Québec's onshore and offshore hydrocarbon potential is incomplete from a geological and technical standpoint. The situation must be more fully documented. Before deciding on the next steps, under the *Government Action Plan on Hydrocarbons* made public on May 30, 2014, two strategic environmental assessments were launched, which are under way. The studies focus on the environment, the economy, society, transportation and technical aspects. They will enable the government to significantly broaden current knowledge and knowledge of the issues at stake.

In the meantime, it should be noted that exploration activities at extraction trials are continuing during the 2015 season in the Gaspé Peninsula and on the Île d'Anticosti. They will more broadly reveal the presence or absence of a certain potential. It is only subsequently that we will have a better idea of the steps that follow. It is important, therefore, to establish the necessary mechanisms to ensure the sound assessment of potential.

The process must strike a balance between hydrocarbon development and GHG reduction objectives while ensuring individual safety and environmental protection. It should be noted here that the challenge related to possible oil and shale gas exploration is a key concern of Quebecers and various interveners.

Accordingly, the existing legislative and regulatory framework must be modernized, which explains the government's stated determination to adopt in 2016 a new integrated statute governing hydrocarbons.

The form of government involvement in respect of businesses that develop hydrocarbons remains to be defined. It may not simply reproduce that prevailing in other sectors such as electricity given the nature of the industry and the high financial risks associated with hazards.

The question of GHG emitted by possible Québec hydrocarbon production and the protection of biodiversity must be subject to rigorous analyses. Even if the shift of emissions from exporting countries to Québec imposed additional efforts to meet the targets that it has set, the shift would not for all that worsen worldwide GHG emissions.

QUESTIONS

- Is Québec's hydrocarbon production likely to tangibly improve the security and diversity of Québec's supplies?
- What criteria should Québec consider to ensure that local natural gas and oil production is acceptable at one and the same time to Québec society and the host communities directly affected by possible exploitation activities?
- Would exploration for and the exploitation of Québec's hydrocarbon reserves offer sufficient benefits to Québec society, considering the attendant potential risks for the environment and local populations?
- What must we absolutely know in order to properly assess the relevance of proceeding or not proceeding with hydrocarbon development?
- Is it possible to reconcile local hydrocarbon production with the principles of sustainable development and Québec's commitments respecting GHG reduction and sustainable development?
- What pitfalls must the government avoid in the choice and adaptation of the best practices implemented in other producing countries to ensure individual safety, respect for communities and environmental protection?
- In order for hydrocarbon development to be advantageous, what would be the best mode of governance and involvement to emphasize in the Québec context?
- What role should the Régie de l'énergie play in the assessment of hydrocarbon exploration and exploitation projects?

CHALLENGES RELATED TO ECONOMIC DEVELOPMENT

Numerous sectors of the Québec economy depend directly on the value chain of fossil hydrocarbons, such as the manufacture of asphalting products, chemical products, construction materials or plastics. Considerable economic activity in Québec stems from the value chain, which must be taken into account in its industrial development.

In the same way, economic spinoff from projects to expand the ability to transport hydrocarbons to and in Québec are not necessarily confined to consumers. Such spinoff must, therefore, be evaluated for all of the activities that the projects would allow, including the risks that they would introduce or reduce.

Thus, for any hydrocarbon project involving or serving Québec (exploitation, transportation, refining), we must ensure satisfactory economic spinoff for Québec society, which also implies the adoption of a new legislative framework and competitive, fair tax rules.

Furthermore, we must reflect about the role of the government and the private sector in infrastructure projects aimed at transporting competitively priced energy products to remote areas to ensure their economic and social development.

We must also ensure that we distinguish the approach to be applied to each petroleum and gas product, e.g. gasoline, fuel oil, LNG, and so on, according to each one's specific advantages and drawbacks.

QUESTIONS

- How can Québec optimize the economic impact of projects such as new oil or natural gas transportation infrastructure such as the Energy East Pipeline.
- What tax measures and royalties might be adopted to promote possible Québec oil and natural gas production were the government to first decide to develop this option?
- Should we impose obligations in respect of regional economic development on businesses that wish to develop Québec's hydrocarbon resources?
- What latitude must we grant the Régie de l'énergie to authorize the development, testing or use of new technologies or new practices in order to support innovation and regional economic development?

CONCLUSION

As is the case elsewhere in the world, hydrocarbons will continue to play a key role in the Québec economy in the short and medium terms. They are posing significant challenges for Québec but are also offering potential. However, the choices underpinning an energy strategy governing oil and natural gas must be made bearing in mind conditions in Québec, the different options and alternate solutions available as regards energy, whether or not hydrocarbons are considered, and the attendant economic, environmental and social benefits and drawbacks.

Under *Québec's 2016-2025 Energy Policy*, the choices must also take into account the objectives adopted with respect to energy efficiency. In the case of hydrocarbons, the transportation sector is a key factor in such challenges. The enhancement of energy efficiency in the sector, in addition to sources of renewable energy to reduce its consumption is an essential factor linked to Québec's GHG emissions targets.

Québec's heavy dependence on hydrocarbon imports must be regarded as one of the factors that guide such choices. However, such dependence must be grasped in terms of its distinctive nature, i.e. according to trade balance, risks linked to transportation over long distances, and the benefits and drawbacks of possible local production.

This opportunity to develop a Québec oil and natural gas production industry cannot proceed without a comprehensive perspective of the economic, fiscal, social, cultural and environmental dimensions. The elaboration of a clear framework for Québec, including not only the legislative, regulatory and fiscal framework but also the objectives, risk management, clarification of the role to be played by governments, the municipalities and businesses, and the social acceptability of different projects should allow for a development environment acceptable to all of the concerned parties.

It is essential to adopt a comprehensive perspective that combines the short and long terms in respect of all of these challenges and all of this potential in order to elaborate a coherent energy policy that benefits from Québec's advantages in the realm of energy. Québec's environmental leadership must relate realistically to the North American and worldwide hydrocarbon sector, but this should not prevent longer-term planning aimed at satisfying the needs of responsible consumption of different energy resources necessary for the prosperity of Québec and its regions.

The development of hydrocarbon production in Québec must reflect a medium- and long-term perspective of the reduction of their place in Québec's economy and a reduction in their importance in our energy consumption.

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APPENDIX 1 – SUMMARY OF THE STATE OF KNOWLEDGE ON HYDROCARBON PRODUCTION IN QUÉBEC

The following tables are drawn from the literature review on the environmental impacts of hydrocarbon development in Québec of the International Reference Centre for the Life Cycle of Products, Processes and Services (CIRAIG). The following table is reproduced from CIRAIG (2014) and summarizes the potential environmental impacts of fossil hydrocarbon production in Québec and the level of knowledge applicable to such impacts. The CIRAIG indicates the confidence level by a colour code to facilitate its interpretation:

- Red: knowledge is insufficient or lacking
- Yellow: relative knowledge but requiring additional research on various aspects
- Green: acceptable state of knowledge

It should also be noted that the numerous references used to present this summarized information are not indicated to avoid cluttering the table, but can be found in the full CIRAIG document (2014).

Table A.1
Summary of knowledge of assumed extraction techniques and the biophysical and ecological characteristics of the regions targeted

Region	Hydrocarbon present	Extraction technique	Biophysical characteristics		Ecological characteristics
			Geological conditions: assumed strata targeted by exploration and exploitation	Vulnerability of aquifers	Biodiversity
Terrestrial environment					
St. Lawrence Lowlands	Shale gas	Hydraulic fracturing	Utica Shale	Vulnerability to surface contamination: known Vulnerability to underground contamination: unknown	One of the richest in Canada (Québec and Canadian legislation has identified special concern species)
	Conventional natural gas	Conventional extraction	Unconsolidated sediments		
Île d'Anticosti	Unconventional	Hydraulic fracturing	Macasty Shale	Unknown	A unique territory in Québec (Québec and Canadian legislation has identified special concern species)
	Conventional	Conventional extraction	Upper and Lower Ordovician		
Gaspé Peninsula	Conventional	Conventional extraction	York River for the Haldimand deposit	Solely around the Haldimand deposit Vulnerability to underground contamination: unknown	Little information (Québec and Canadian legislation has identified special concern species)
	Unconventional	Hydraulic fracturing			
Bas-Saint-Laurent	Conventional	Conventional extraction	Ordovician, Devonian	Unknown	Little information (Québec and Canadian legislation has identified special concern species)
	Unconventional	Hydraulic fracturing			
Marine environment					
St. Lawrence estuary	Conventional	Conventional extraction	Lower and Upper Ordovician, hyrdrothermal brechias of the Ordovician carbonate platform	NA	One of the richest in the world (Québec and Canadian legislation has identified special concern species)
Gulf of St. Lawrence	Conventional	Conventional extraction	Carboniferous and Upper and Lower Ordovician	NA	One of the richest in the world (Québec and Canadian legislation has identified special concern species)

Table A.2
Summary of knowledge of the analysis of the life cycle and airborne emissions of the regions targeted

Region	Hydrocarbon	Comprehensive assessment of potential impacts through an analysis of the life cycle			Airborne emissions	
		Analysis of the life cycle	Specific to Québec?	Contributing stages	Assessment of air quality and odours	GHG emissions (g CO_2 eq./MJ)
Terrestrial environment						
St. Lawrence Lowlands	Shale gas	Yes	Yes	Yes	Local to regional risk	7 to 34 Uncertain estimate
	Conventional natural gas		No		Unknown	7 to 21
Île d'Anticosti	Shale oil	No	Unknown	Unknown	Unknown	9 to 13 Highly uncertain estimate
	Conventional oil	Yes	No	Yes		12 to 47
	Conventional natural gas					7 to 21
Gaspé Peninsula	Conventional oil	Yes	No	Yes	Unknown	12 to 47
	Conventional natural gas					7 to 21
	Shale gas		Yes			7 to 34 Uncertain estimate
	Shale oil	No	Unknown	Unknown		9 to 13 Highly uncertain estimate
Bas-Saint-Laurent	Conventional oil	Yes	No	Yes	Unknown	12 to 47
	Conventional natural gas	No	Unknown	Unknown		7 to 21
	Shale gas	Yes	Yes	Yes		7 to 34 Uncertain estimate
	Shale oil	No	Unknown	Unknown		9 to 13 Highly uncertain estimate
Marine environment						
St. Lawrence estuary	Conventional oil	Yes	No	Yes	Unknown	10 to 28
	Conventional natural gas					7 Uncertain estimate
Gulf of St. Lawrence including Old Harry	Conventional oil	Yes	No	Yes	Unknown	10 to 28
	Conventional natural gas					7 Highly uncertain estimate

Table A.3

Summary of knowledge of the potential impacts on water, soils and sediments in the regions targeted

Region	Hydrocarbon	Impacts on water				Impacts on soils and sediments
		Water withdrawal (m^3/MJ)	Withdrawal target	Groundwater contamination	Surface water contamination	Main source of potential contamination
Terrestrial environment						
St. Lawrence Lowlands	Shale gas	4.7	Surface water	Observations : 6% of samples for natural gas contamination and possible contamination by fracturing fluids	Effluent contamination from municipal or specialized processing plants Quantification of impacts: unknown	Accidental spills of hydrocarbons, drilling sludge, fracturing fluids, wastewater
	Conventional natural gas	≈ 0	Unnecessary	Observations : Nearly 4% of wells display leaks at the well vent and 0.6% in the formwork (based on Alberta)		
Île d'Anticosti	Shale oil	Unknown	Unknown	Unknown		
	Conventional oil	367				
	Conventional natural gas	≈ 0	Unnecessary			
Gaspé Peninsula	Conventional oil	367	Unknown	Unknown		
	Conventional natural gas	0	Unnecessary	Unknown		
	Shale gas	4.7	Unknown	See lowlands		
	Shale oil	Unknown				
Bas-Saint-Laurent	Conventional oil	367	Unknown	Unknown		
	Conventional natural gas	≈ 0	Unnecessary	Unknown		
	Shale gas	4.7	Unknown	See lowlands		
	Shale oil	Unknown				
Marine environment						
St. Lawrence estuary	Conventional oil	227	Estuary water	NA	Wastewater effluent contamination within a 500-m minimum radius Low-risk zones but with major impact in the event of an accidental spill Quantification of the impacts: unknown	Drill cuttings potentially contaminating a zone of nearly 5 km to 10 km around a borehole
	Conventional natural gas	≈ 0	Unnecessary			
Gulf of St. Lawrence including Old Harry	Conventional oil	227	Gulf waters			
	Conventional natural gas	≈ 0	Unnecessary			

Table A.4
Summary of knowledge of the potential impacts on wildlife, habitats and ecosystems in the regions targeted

Region	Hydrocarbon	Impacts and wildlife and habitats			Impacts on ecosystems
		Sources of potential impacts	Potential impacts	Assessment of the extent of potential impacts in the study area	Extent of the consequences on ecosystems
Terrestrial environment					
St. Lawrence Lowlands	Shale gas	Overall climate change Modification, fragmentation and reduction in the size of habitats Possible destruction of forest cover and replacement by invasive vegetation Water withdrawal Ecotoxic substance emissions Infrastructure construction (pipelines, roads, and so on)	Reduction in biodiversity Changes in animal behaviour Habitat degradation	No	Ecosystems will be adversely affected. It is, for the time being, impossible to assess this scope since several potential impacts have only been qualitatively assessed. Numerous indirect impacts have yet to be determined, as is true of synergistic, multiplicative and cumulative impacts.
	Conventional natural gas				
Île d'Anticosti	Shale oil				
	Conventional oil				
	Conventional natural gas				
Gaspé Peninsula	Conventional oil				
	Conventional natural gas				
	Shale gas				
	Shale oil				
Bas-Saint-Laurent	Conventional oil				
	Conventional natural gas				
	Shale gas				
	Shale oil				
Marine environment					
St. Lawrence estuary	Conventional oil	Overall climate change Seismic surveys Luminosity Increase in the spread of diseases Construction and presence of infrastructure (pipelines, roads, and so on) Ecotoxic substance emissions	Reduction in biodiversity Changes in animal behaviour Habitat degradation	No	Ecosystems will be adversely affected. It is, for the time being, impossible to assess this scope since several potential impacts have only been qualitatively assessed. Numerous indirect impacts have yet to be determined, as is true of synergistic, multiplicative and cumulative impacts.
	Conventional natural gas				
Gulf of St. Lawrence including Old Harry	Conventional oil				
	Conventional natural gas				

APPENDIX 2 – UNITS OF MEASUREMENT AND CONVERSION FACTORS

Size	Unit	Acronym	Equivalency factor
Energy	Ton oil equivalent	toe	NA
	Joule	J	41.87 GJ/toe
	Watt	W	11 630 kWh/toe
	British Thermal Units	BTU	39.68×10^6 BTU/toe
Mass	Tonne	t	1000 kg/t
Volume	Cubic metre	m^3	35.31 ft^3/m^3
	Barrel	b	0.1637 m^3
GHG emissions	Tonne equivalent CO_2	t eq.CO_2	NA

Product	Volume corresponding to 1 toe of energy	GHG emissions (t. eq. CO_2)
Oil[51]	1 07127 m^3 6.8 barrels	3.10
Natural gas[52]	1 100 m^3	2.10
Gasoline	1.20 m^3	2.86
Diesel	1.09 m^3	3.02
Light fuel oil	1.07 m^3	2.95
Heavy fuel oil	0.98 m^3	3.10
Propane	1.66 m3	2.53

Prefixes of decimal multiples		
Peta (P)	10^{15}	quadrillion
Tera (T)	10^{12}	trillion
Giga (G)	10^9	billion
Mega (M)	10^6	million
Kilo (k)	10^3	thousand

51 The ministère de l'Énergie et des Ressources naturelles uses a conversion factor of 6.76 barrels of toe, obtained using a combination of coefficients supplied by Statistics Canada and the OECD. The IEA proposes a conversion factor of 7.3 barrels of oil per toe.

52 The wholesale price of natural gas in North America is negotiated in thousands of thousands of BTUs (MMBTU), while transportation and sale to customers are set by volume. The volume, out of the United States, is measured in standardized cubic feet, while it is marketed in cubic metres in Canada. One cubic foot of natural gas contains 1 031 BTU and one cubic metre contains 36 400. To illustrate, it should be noted that one litre of gasoline provides roughly 34 000 BTU and one litre of diesel fuel, roughly 40 000 BTU.

Québec