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Montreal Economic Institute

Ideas for a More Prosperous Nation

DECEMBER 2014

CAN WE GET RID OF OIL?

THE COSTS OF AN ACCELERATED ENERGY TRANSITION

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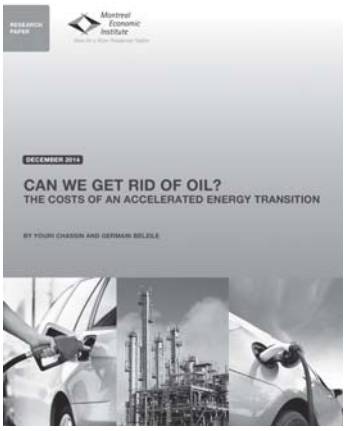


Policies designed to accelerate the transition to green energy sources are usually presented in terms of their benefits, whereas costs are rarely discussed. This *Research Paper* proposes to fill this gap in the public debate. It examines the costs of proposals made by the Quebec environmentalist groups Équiterre and Vivre en ville for rapidly reducing oil consumption, as well as the willingness of Quebecers and other Canadians to pay those costs.

First, an overview of oil production and consumption shows that this energy source will not be in short supply for many decades to come. Since 1980, proven reserves of oil have increased by 147% despite steadily increasing consumption. Whereas they were sufficient to cover 30 years of consumption in 1980, current proven reserves of oil are sufficient for the next 53 years. Morever, because oil fills numerous needs, replacing it is neither easy nor practical given the current state of technology.

The proposals of Équiterre and Vivre en ville for reducing oil consumption are examined in detail. Their declared objective is to reduce the consumption of gasoline for personal transportation by 60%, which would however only entail a 20% reduction in total oil consumption and a 12% reduction in GHG emissions.

According to our calculations, based on prudent hypotheses, the annual cost of these proposals is estimated at $6.4 billion for Quebec as a whole, or $1,875 per household. The two environmentalist groups seriously underestimate certain costs. For example, the idea of implementing a bicycle sharing service like BIXI in several municipalities would cost not $40 million, but rather $101 million. Likewise, interregional train projects and high-speed rail service for the Quebec-Windsor corridor are onerous projects that have to be accounted for, and which amount to the equivalent of nearly $1.9 billion per year.

Arguments about economic spillover, the reduction of imports and the creation of green jobs, often raised to illustrate other advantages of these proposals, contradict basic premises of economic analysis. Subsidizing a job clearly requires levying taxes elsewhere in the economy that in turn destroy unsubsidized jobs. In Ontario, each green energy job costs over $179,000. In Italy, it is estimated that the subsidy provided for the creation of a "green" job leads to the destruction of 4.8 jobs elsewhere in the economy.

An exclusive pan-Canadian poll reveals that only 13% of Canadians and 12% of Quebecers are willing to spend $1,500 or more each year to reduce oil consumption by 25%. Moreover, there is no guarantee that the means proposed by Équiterre and Vivre en ville would actually achieve this objective. The most concrete and plausible way of achieving it would be to double the price of gasoline. This solution also hardly seems possible since only 8% of Canadians would be willing to pay $2.80 per litre of gasoline.

In sum, the projects proposed by Équiterre and Vivre en ville would probably not achieve their stated objectives, and Canadians do not want to pay for them. Technological progress will certainly allow us to reduce our oil consumption in the medium term and move to cleaner energy sources. In the meantime, we should do a better job in the public debate of taking into account the costs of the proposals of environmentalist groups for accelerating this transition to greener energy sources.

INTRODUCTION

Oil is an energy source that is indispensable to the proper functioning of a modern economy. In Canada, it is the main source of energy used, meeting 40.5% of total energy needs.[1] Its characteristics, including its energy density, make it a preferred source of energy in the transportation sector. Its molecular composition also makes petroleum by-products very useful for the petrochemical industry. On the other hand, the combustion of oil releases pollutants and greenhouse gases (GHGs) into the atmosphere. Among the countries of the world, Canada was the 15th largest emitter of GHGs per capita in 2010.[2]

Some people think that oil has more drawbacks than advantages, and they call for governments to intervene vigorously to reduce oil consumption in Canada. According to them, the extensive role that oil plays in our lives and our economy means that we are "dependent on oil."

The notion of dependence is misleading, however. While the use of oil as an energy source has some disadvantages and generates pollution, it also has significant advantages, especially when it comes to the transportation of people and goods. As with many other products and services, the consumption of oil entails both costs and benefits.

The decision to use or not to use oil as an energy source depends on the existence of alternatives. Especially in the transportation sector, the growing presence of electric vehicles and of trucks that run on natural gas are some good examples. Cars that use hydrogen fuel cells could be another option.

However, these other choices have drawbacks as well as advantages, and can be expensive. In time, so-called clean technologies will probably improve and become more competitive economically. The relative price of oil could also rise, since it is after all a finite resource, though an abundant one. As has happened many times in the history of humanity, scientific and technological progress could then lead to an energy transition, which is to say a significant change in the most widely used forms of energy.

Reducing global consumption of oil and other fossil fuels is desirable, if only to reduce the atmospheric pollution and GHG emissions that these forms of energy generate, which would have positive effects in terms of people's health and safety. However, replacing an energy source like oil with other energy sources will be a very gradual process.

This *Research Paper* explores the following question: Can this energy transition be accelerated, as many groups suggest insistently, in a way that is both effective and affordable? Everyone agrees that we will in all likelihood have to rely on fossil fuels for many more years, even decades. Even if consumption were drastically reduced in 40 or 50 years, it is highly improbable that oil would disappear completely from our lives. After all, when oil replaced coal as our main energy source, the latter did not completely disappear from the picture and is still used today in appreciable quantities.[3] In addition to this example from the past, this *Research Paper* analyzes our current use of oil and the outlook for the coming decades.

"Reducing global consumption of oil and other fossil fuels is desirable. However, replacing an energy source like oil with other energy sources will be a very gradual process."

The first chapter sketches a picture of how oil is currently used in Canada and discusses its relative scarcity or abundance. The second chapter focuses more specifically on a proposal from two Quebec environmentalist groups, Équiterre and Vivre en ville, whose goal is to "liberate" Quebec from oil by 2030, barely fifteen years from now. The cost of the proposed means for doing so, and their effectiveness, provides a better idea of what we are talking about when it comes to reducing oil consumption through government measures.

1. Statistics Canada, *Report on Energy Supply and Demand in Canada: 2011 Revision*, January 2014.
2. The data for 2010 are the most recent available for nearly 200 countries. The World Bank, CO2 emissions (metric tons per capita).
3. Pierre Desrochers and Hiroko Shimizu, "Innovation and the Greening of Alberta's Oil Sands," *Research Paper*, Montreal Economic Institute, October 2012, p. 10.

After this overview, the second chapter also reminds us that Canada already has measures in place aimed at reducing oil consumption. It deals with the possibility that the costs of an accelerated energy transition could be offset by decreasing oil imports or by the creation of "green" jobs.

The third and final chapter discusses the efforts that Canadians are prepared to make to reduce their oil consumption, an important aspect in any economic decision. Thanks to a pan-Canadian survey, public opinion on this matter is examined in detail.

CHAPTER 1

The Importance of Oil in Today's World

Canada produces approximately 4 million barrels of oil a day, which puts it in fifth place among the countries of the world, in addition to being among the top 10 oil exporting countries.[4] In certain parts of Canada, however, oil is imported from abroad because Canadian oil does not reach all of the country's refineries.[5]

With 173.6 billion barrels of proven reserves located primarily in the oil sands, Canada ranks just behind Saudi Arabia (267 billion barrels) and Venezuela (211 billion barrels).[6] The economic importance of oil to the country, already sizable, can be expected to continue.

One justification used by supporters of an energy transition or of a reduction in oil consumption is the non-renewable character of fossil fuels in general and of oil in particular.[7] Global oil reserves are indeed limited, and we will have to turn to other sources of energy at some point. But according to them, it is important to start preparing ourselves now by substituting renewable energy sources for oil, even if these have to be supported by government subsidies.

It is therefore pertinent to begin by looking into the relative scarcity of this resource. This will give us a better idea of whether we will be able to continue using oil in the years and decades to come before we examine the possibility of doing without in the short term.

A Non-Renewable but Abundant Energy Source

Oil is not considered a renewable energy source since it is formed in nature by fossilized organic matter in a process that takes millions of years. On a human timescale, it is therefore a resource whose quantity is limited. Technologies for the artificial production of oil have not yet been able to compete with oil extracted from natural reserves.

While they are by definition limited, global oil reserves are nonetheless considerable. The industrial use of oil dates back about a century. During this period, access to new areas of exploration and the emergence of new extraction technologies that are ever more sophisticated and ever less expensive have led proven oil reserves to grow steadily.

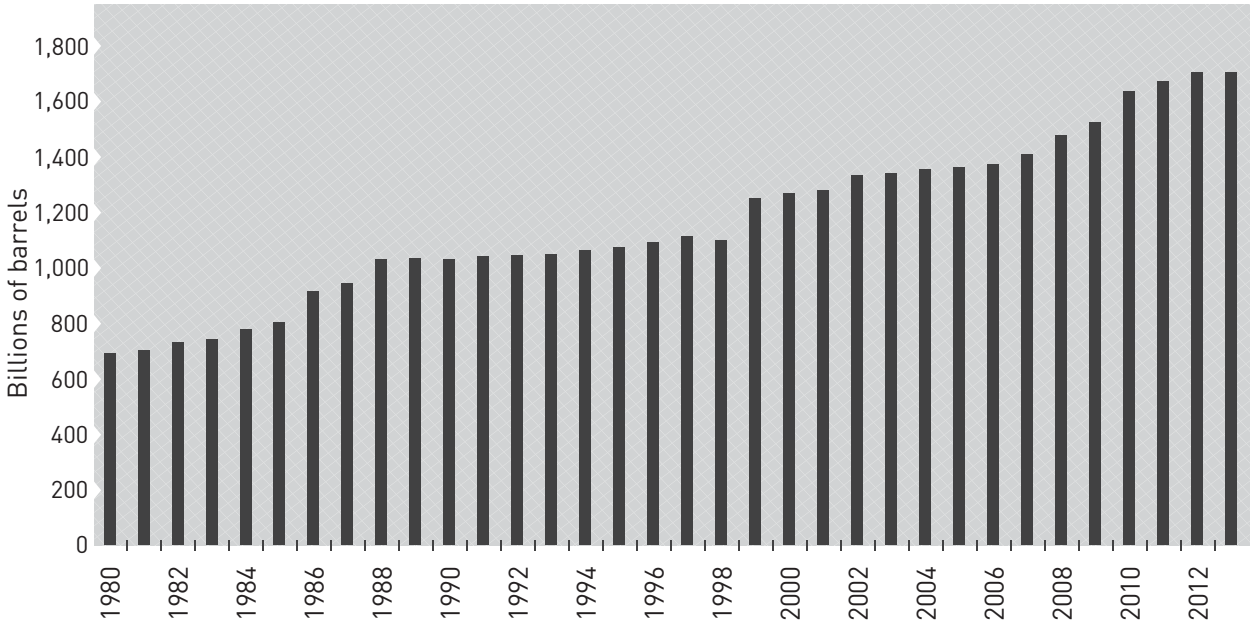
"For the past thirty years, the quantities of proven reserves have grown more rapidly than production, constantly pushing back the moment when these resources will be exhausted."

Proven oil reserves are "the estimated quantities of oil which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under current economic and operating conditions."[8]

In 1980, these reserves totalled 683.4 billion barrels of oil. Since then, humanity has continued to extract and use more and more of it, but despite this, proven reserves have increased continually over the past thirty years, except for a single year when they decreased slightly. Proven reserves of oil amounted

4. U.S. Energy Information Administration, Canada: Country Analysis Brief Overview.
5. The construction of pipelines and the re-reversal of Enbridge's 9B pipeline are projects whose aim is precisely to open up new markets.
6. Canadian Association of Petroleum Producers, *Crude Oil: Forecast, Markets & Transportation*, 2013, p. i; U.S. Energy Information Administration, Proved reserves.
7. See Ianik Marcil, "Innover, pas extraire," *Journal de Montréal*, October 20, 2014, p. 37: "One day, there will be no more oil on the planet. No one knows when this will happen. On the other hand, oil being a non-renewable resource, its reserves will someday be depleted, by definition. Faced with this inevitable expiry date, rather than spending money and effort developing an industry that will soon be obsolete, let's see the 'end of oil' as a golden opportunity for the future of Quebec"; and also Tides Canada, *Towards a Clean Energy Accord: How and Why a Canadian Energy Strategy Can Accelerate the Nation's Transition to a Low-Carbon Economy*, June 2012.
8. BP, Oil reserve definitions.

Figure 1-1
The evolution of proven global oil reserves



Source: BP, Statistical Review of World Energy 2014, Historical Data Workbook, Oil - Proved reserves history, June 2014.

to 1,687.9 billion barrels in 2013, a 147% increase[9] (see Figure 1-1).

The same phenomenon can be illustrated in a different way. The "reserves-to-production" ratio indicates the number of years that current reserves will last if production remains at the current level. This figure was 30.6 years in 1980, which means that other things being equal, we were going to run out of oil in 2010. Not only did this not happen, but by the end of 2013, the same ratio had climbed to 53.3 years.[10] This means that for the past thirty years, the quantities of proven reserves have grown more rapidly than production, constantly pushing back the moment when these resources will be exhausted.

More recently, the high price of oil has stimulated innovation and encouraged the ingenuity and perseverance of entrepreneurs in increasing the supply of oil in the United States and Canada. Significant technological advances have improved the recovery rate of existing oilfields and have made possible the cost-effective development of resources that were previously inaccessible.

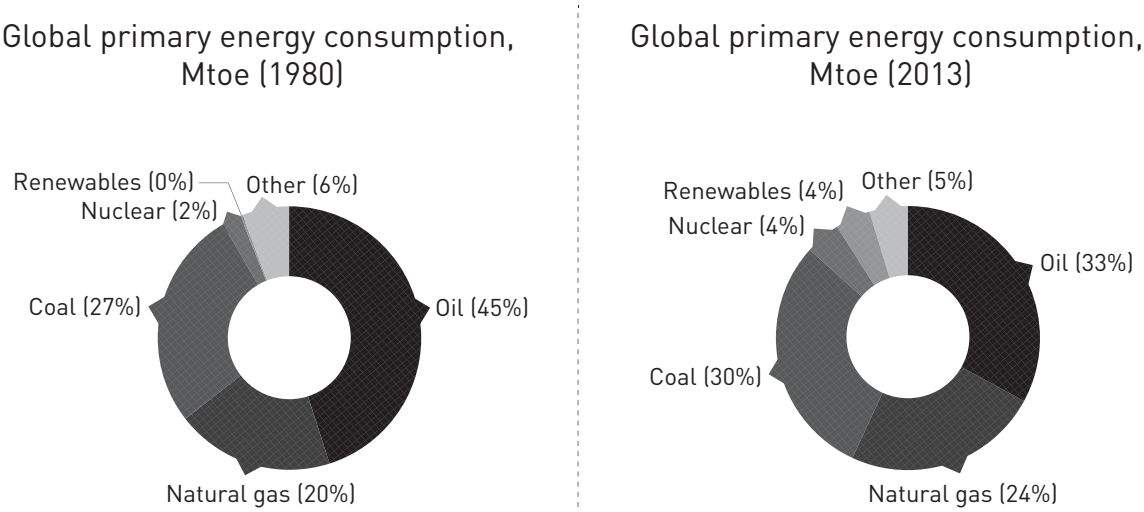
There will therefore be no shortage of oil in the world for at least the next 50 years, and it is very likely that this length of time will be extended thanks to technological advances that will take place during this period. Not only will Canada have enough oil to develop its economy and meet the energy needs of its population; it will also be able to export the bulk of its production to other markets, including the United States and emerging countries where the demand for energy is in full expansion.

The Relative Decline of Oil

While there is no crisis on the horizon, it is likely that oil will represent a smaller share of global energy consumption in the future. This form of energy currently meets 33% of the planet's energy needs, versus 45% in 1980. This decline is relative, since oil consumption has increased over this period. Oil is

9. BP, Statistical Review of World Energy 2014, Historical Data Workbook, Oil – Proved reserves history, June 2014.
10. BP, Statistical Review of World Energy 2014, Historical Data Workbook: Oil – Proved reserves, Oil – Proved reserves history, Oil consumption – Barrels, June 2014.

Figure 1-2
Proportion of global consumption of various forms of energy



Source: BP, Historical Data Workbook.

still humanity's primary source of energy. However, other forms of energy are becoming more important, like renewable energy (see Figure 1-2). Practically nonexistent in the energy mix in 1980, today it represents 4% of the total.

Just as technological change leads to increases in proven oil reserves, it also favours the development of other forms of energy that are becoming increasingly affordable. Solar panels, to take one example, are more and more effective and less and less expensive. The cost of a solar panel module per watt of capacity has gone from US$76.67 in 1977 to less than $10 in 1987 and to $0.74 today (see Figure 1-3).

Largely absent until the 1990s, solar power has increasingly been used to produce electricity. As shown in Figure 1-4, it has experienced exceptional growth starting around the year 2000, increasing from 1,250 megawatts to 139,637 megawatts in 2013.

The greater presence of renewable energy sources like wind, solar and geothermal is certainly due to them being more affordable, which is essentially the result of technological change. It is also partly explained by the financial support of government subsidies.

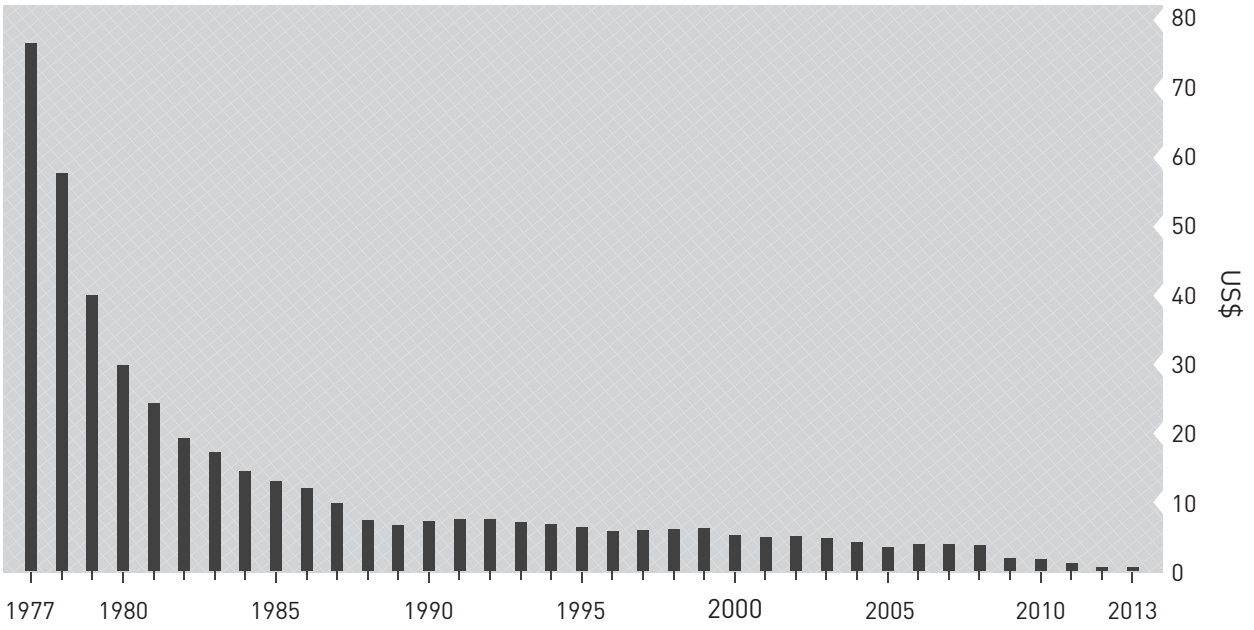
Given time and future scientific breakthroughs, one can imagine that these subsidies will no longer be necessary and that renewables will naturally take their place in the energy consumption of the world. Nonetheless, until that point and even thereafter, oil will continue to meet the energy needs of humanity and even to serve other purposes.

The Use of Oil in Our Daily Lives: Energy for Transportation

Oil is used particularly in the transportation sector. In Canada, the main petroleum-derived products we consume are gasoline, at 43% of the total, followed by diesel, at 27%. Gasoline is more associated with the transportation of people, while the use of diesel is more widespread in the transport of goods. Far behind these two products, we find kerosene and other fuels for airplanes, which represent just 6% of consumption.[11] Among all of the products derived from oil, only around 15% of them are not consumed as fuels, but are used for other purposes (see Figure 1-5).

11. Natural Resources Canada, *Canadian Crude Oil, Natural Gas and Petroleum Products: Review of 2009 and Outlook to 2030*, May 2011, p. 21.

Figure 1-3
Price of a solar panel module per watt of capacity



Source: "Pricing sunshine: The rise of solar energy," *The Economist*, December 28, 2012.

In other words, although it is through our personal vehicles that we most often make use of petroleum products, these do not even account for the majority of oil consumed. The corollary of this is that despite all of our efforts devoted to reducing the consumption of gasoline by automobiles, to improving their energy efficiency or to promoting electric vehicles, these policies address less than half of the country's oil consumption.

"The greater presence of renewable energy sources is partly explained by the financial support of government subsidies."

Finally, oil is also a source of energy in areas other than transportation, although less than 10% of Canadians heat their homes with oil, and only 1.2% of Canada's electricity is produced from oil.[12]

The Use of Oil in Our Daily Lives: Plastics

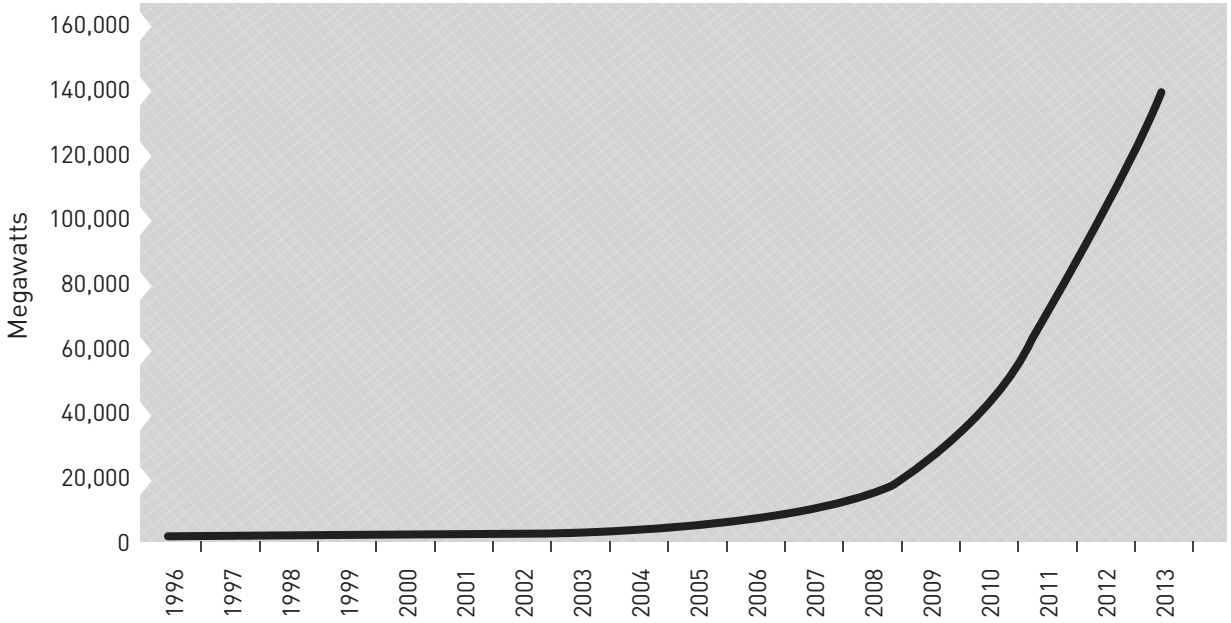
While oil is first and foremost a source of energy, we also use it for other purposes. A true raw material for the petrochemical industry, oil is a component of plastics and other materials that are found in a multitude of objects.

These are basically polymers that are used in many areas because of their various properties. They can be rigid or supple, transparent or opaque, superabsorbent or waterproof, soluble or insoluble in water, thermoplastic or thermosetting, electrical conductors or insulators.

These polymers are found under various forms in our daily lives. They are present in our houses as plastic containers, shower curtains, toys, electrical appliances and devices, flooring, school supplies, Teflon kitchen items, clothing made from polyester, nylon and other synthetic fabrics, patio furniture, candles, mattresses, and so on.

12. Montreal Economic Institute, *Canada's Energy Profile in 40 Questions*, "Question 10: How do Canadians heat their homes?" 2014; Natural Resources Canada, About Electricity, March 2014.

Figure 1-4
World production of electricity from solar power



Source : BP, Statistical Review of World Energy 2014, Historical Data Workbook, Renewable energy – solar, Cumulative installed photovoltaic (PV) power.

In the field of health and well-being, polymers are used to make heart valves, hearing aids, contact lenses, pharmaceuticals, perfumes, makeup, shampoo, shaving cream, disposable diapers, and toothpaste, among other things.

When it comes to sports and leisure, polymers are used in the manufacture of sports equipment, various balls, protective gear, CDs and DVDs, and fishing line.

"A true raw material for the petrochemical industry, oil is a component of plastics and other materials that are found in a multitude of objects."

Some industrial products made from polymers include tires, automobile interiors, glue, wood substitutes, pipes, paints, insulation, packaging material, and water treatment.

Finally, in agriculture, they are used to make fertilizer, insecticides, agricultural equipment, and high-absorption products, just to name a few.[13]

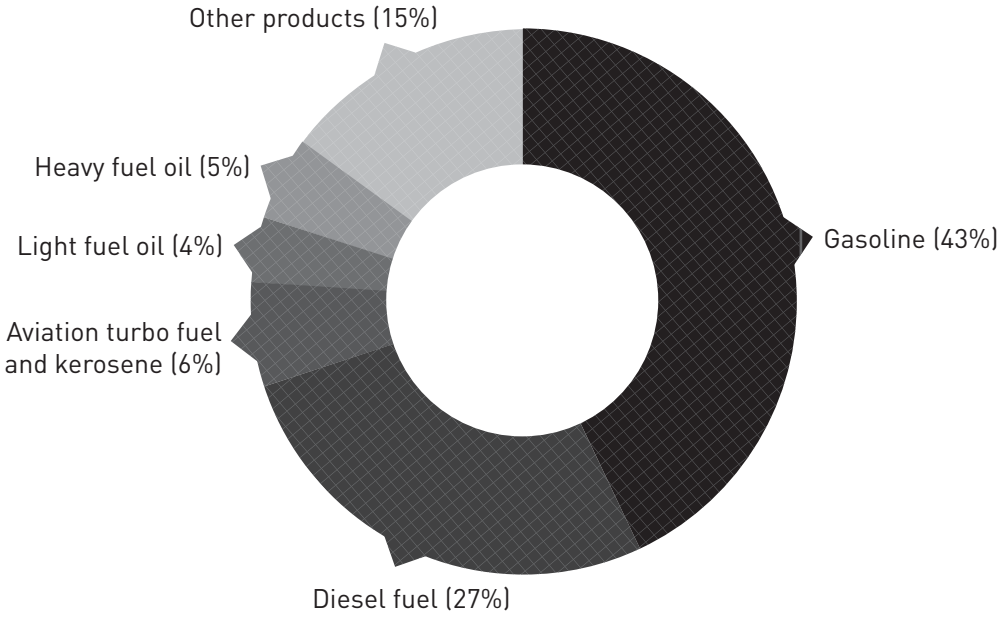
The Challenge of Replacing Oil in Sweden

The unavoidable presence of oil and its by-products in our daily lives makes it very difficult to get by without it. Certain countries have nonetheless adopted public policies whose aim is to transition away from fossil fuels. These policies have proven to be expensive, and have at times been vigorously challenged.

The most emblematic case is without a doubt that of Sweden. Hit by the oil crises of 1973 and 1979, Sweden tried to reduce its consumption of hydrocarbons, including oil. After more than thirty years, it achieved a certain amount of success, but the goal of doing without oil no longer seems very realistic.

13. Montreal Economic Institute, *op. cit.*, footnote 12, "Question 12: What is oil good for?"

Figure 1-5
The consumption of petroleum products in Canada



Source: Natural Resources Canada, *Canadian Crude Oil, Natural Gas and Petroleum Products: Review of 2009 and Outlook to 2030*, May 2011, p. 21.

In the 1970s, oil represented around three quarters of Sweden's energy supply. Today, its share has fallen considerably, to just 21.5% of consumption, primarily due to its decreased use for heating homes. As for electricity production, 80% is produced using nuclear power and hydropower and 4% using wind power. The use of fossil fuels is now limited mostly to the transportation sector.[14]

The originality of Sweden's approach is that it is the industrialized country that has gone furthest in its thinking in order to do without oil. Indeed, in December 2005, the Swedish government established the *Commission on Oil Independence*, whose mission was to come up with a program to bring an end to Sweden's "dependence" on oil by the year 2020. The concerns of the Swedish government at the time were basically climate change, the rising price of oil and the possibility of a global oil shortage.

The Commission's June 2006 report, entitled *Making Sweden an Oil Free Society*, recommended reducing oil consumption for road transportation by 40% to 50% through greater fuel efficiency and the use of biofuels like ethanol.[15]

Although Sweden was unable to achieve its goal of going without oil for the time being, it is nonetheless the member country of the International Energy Agency (IEA) where the share of fossil fuels in the energy supply mix is the lowest. However, if the overall demand for oil in Sweden is likely to fall during the coming decade, the transportation sector's demand for oil is likely to grow, according to the IEA. In 2011, 61% of the demand for oil came from the transportation sector, and 22% from the industrial sector. Far from declining, demand in the transportation sector actually rose at an annual rate of 0.6% from 2000 to 2010.[16]

The Swedish government recognizes that progress in replacing oil with biofuels and other

14. Government of Sweden, "Energy: Generating power for a sustainable future," August 2013, p. 1.

15. Prime Minister's Office, *Making Sweden an OIL-FREE Society*, Commission on Oil Independence, July 13, 2006, pp. 1, 4 and 11.

16. International Energy Agency, *Oil & Gas Security: Emergency Response of IEA Countries, Sweden*, 2012, p. 6.

renewable energy sources has been slow. In 2012, the share of renewable energy in the production of fuel was just 9.8%, essentially due to the increased use of ethanol.[17]

Electricity from Renewable Sources in Canada's Provinces

Environmentalists deplore the absence of a federal energy policy to reduce oil consumption in Canada.[18] However, the National Energy Program of the 1980s left people in certain regions of Canada with bitter memories, especially in the Western provinces. Energy policies, moreover, are essentially a provincial jurisdiction.

Ontario has decided to reduce the share of its electricity produced from coal and to develop the production of renewable energy. The *Green Energy Act* adopted in May 2009 rests on a Feed-in Tariff program which is paid for by electricity consumers. According to one estimate, this extra cost amounts to at least $18 billion over the next 20 years.[19] Another study points out that rising tariffs risk compromising the economic competitiveness of businesses in the manufacturing and mining sectors.[20]

The goal was to increase the production of renewable energy by 10,700 megawatts by the year 2013, to make up 13% of the province's total capacity for electricity production. This goal has been pushed back to the year 2021.[21]

Similar programs also exist in Nova Scotia and New Brunswick in the form of "Renewable Energy Standards" that force providers to get a minimum percentage of their electricity supplies from renewable energy sources.[22] In 2006, the Quebec government also got involved in the production of wind power that the province must subsidize in the amount of $695 million a year for energy it does not need.[23] On the whole, the main consequence of these initiatives has been to increase the electricity rates paid by households and businesses.

The Electric Car Option

Since transportation represents the main market for oil, policies aiming to reduce consumption often target this sector. Electric cars, since they use electricity instead of traditional fuels, are felt to be an alternative that could reduce oil consumption in the transportation sector.

"On the whole, the main consequence of these initiatives has been to increase the electricity rates paid by households and businesses."

In order to promote their use, Ontario and Quebec reimburse a portion of the purchase price of these vehicles, from $4,000 to $8,500. Governments also subsidize the purchase and installation of electric charging stations.

As a result of these provincial subsidies, 97% of all electric cars bought in Canada up to now have been sold in Ontario, Quebec and British Columbia.[24] Despite this, electric cars still make up only 0.76% of car sales in these three provinces. Only 8,429 of Canada's 21.3 million cars and light trucks run on electricity, which is 0.04% of the country's automotive fleet.[25]

17. Government of Sweden, *op. cit.*, footnote 14, p. 3.
18. Tides Canada, *op. cit.*, footnote 7, p. 6.
19. Gerry Angevine, Carlos A. Murillo and Nevena Pencheva, *A Sensible Strategy for Renewable Electrical Energy in North America*, The Fraser Institute, 2012, p. 3.
20. Ross R. Mckitrick, *Environmental and Economic Consequences of Ontario's Green Energy Act*, in conjunction with the Fraser Institute Centre for Energy and Natural Resource Studies, April 11, 2013, p. IV.
21. Ontario Ministry of Energy, *Results-based Plan Briefing Book 2011-12*, p. 7; Ontario Ministry of Energy, Ontario's Long-Term Energy Plan.
22. Government of Nova Scotia, *Nova Scotia Department of Energy. Renewable Energy Standard,* 2012; Government of New Brunswick, *Renewable Portfolio Standard,* 2014.
23. Youri Chassin with the collaboration of Guillaume Tremblay, "The Growing Cost of Electricity Production in Quebec," Montreal Economic Institute, 2013.
24. Montreal Economic Institute, *op. cit.*, footnote 12, "Question 30: Are Canadians driving around in electric cars?" British Columbia ended its program in March 2014.
25. WWF, *Transportation rEVolution: Electric Vehicle Status Update 2014*, p. 5. (These data are from August 2014.) Statistics Canada, Motor vehicle registrations, by province and territory, July 2014. (This is the number of light vehicles for 2013.)

Other new vehicle propulsion technologies, such as hydrogen engines, may eventually emerge on the Canadian market and compete with traditional electric cars.

The Ethanol Solution

As we saw with Sweden's experience, supporters of an energy transition place a lot of hope in the replacement of gasoline with biofuels like ethanol. This is a form of alcohol whose combustion produces energy and that can therefore serve as a fuel in the engines of certain vehicles. It is the most widely used biofuel in the transportation sector. Since few engines are designed to run solely on ethanol, this fuel is usually mixed with normal gasoline. In 2012, gasoline sold in Canada contained an average of 5.6% ethanol.

"Replacement options will be developed and will naturally reduce the share of oil in the energy needs of Canadians, a trend that is already underway."

It is a federal government regulation requiring oil companies to sell gasoline containing a minimum of 5% ethanol that creates the Canadian demand for ethanol. In addition, there also exist similar provincial laws. Thanks to the support of federal government subsidies, 1.73 billion litres of ethanol were produced in Canada in 2012, while 2.4 billion litres were consumed.

In Canada, ethanol is produced from two grain crops, namely corn (78%) and wheat (21%). This kind of production is increasingly controversial. The European Union recently decided to limit the importation of ethanol made from agricultural crops because of concerns that this production creates environmental problems and also threatens food security by causing grain prices to rise in developing countries.[26]

Weaning Ourselves off Oil Is neither Urgent nor Easy

The use of oil on a large scale in our societies definitely presents an environmental challenge. This is the case for the petrochemical industry, which is increasingly looking to recycle its plastics. As for the use of oil for energy, its combustion generates atmospheric pollution and greenhouse gases.

These issues are in themselves good reasons to make optimal and parsimonious use of oil. However, the feared shortage of oil often invoked as imminent is not about to occur, at least not within the next fifty or a hundred years. During this time, replacement options will be developed and will naturally reduce the share of oil in the energy needs of Canadians, a trend that is already underway.

Trying to accelerate this process requires always expensive and rarely effective government programs. The experiences of Sweden and Canada show that the odd success comes at a high price.

Within the context of this debate, two Quebec environmentalist groups, Équiterre and Vivre en Ville, produced a detailed document[27] proposing that the province "free itself" from oil by 2030. Exceptionally, this plan includes calculations of the economic costs of the various public policies proposed. The following chapter will therefore study these proposals in order to estimate the cost implied by a decision to accelerate the reduction of oil consumption.

26. Montreal Economic Institute, *op. cit.*, footnote 12, "Question 35: How much ethanol does Canada produce and use?"

27. Équiterre and Vivre en Ville, *Changer de direction : Chantier aménagement du territoire et transport des personnes*, May 2011.

CHAPTER 2

The Cost of Reducing Oil Consumption

In the 2009 report entitled *Pour un Québec libéré du pétrole en 2030* (*For a Quebec liberated from oil in 2030*),[28] the environmentalist group Équiterre proposed several measures aimed at reducing our consumption of fossil fuels—and by the same token, our GHG emissions—in order to fight climate change. Following up on its first report, Équiterre more recently teamed up with Vivre en ville to publish a second document entitled *Changer de direction : Chantier aménagement du territoire et transport des personnes*.[29]

Contrary to what the titles of these publications imply, the complete reorganization of urban planning and transportation infrastructure would not allow Quebecers to rid themselves of their "dependence" on oil. The objective proposed by the authors is rather to reduce gasoline consumption for personal transportation by 60%. This would actually be the equivalent of reducing total oil consumption in Quebec by just 20%.

Although this goal is far less ambitious than that of "liberating Quebec from oil," the measures proposed would nonetheless entail substantial costs. These ambitious projects would impose radical changes on the daily lives of Quebecers.

We evaluated the total annual cost of the measures proposed by Équiterre and Vivre en ville. For the measures that we did not analyze in detail, we simply used their own evaluation (see Table 2-1 for a summary of these evaluations and the Technical Annex on the MEI's website for a detailed explanation of our calculations).

In one case, our evaluation of the costs involved is much higher than the one presented by Équiterre and Vivre en ville. They only assigned 50% of the costs to governments. However, whether the cost is borne by the government, and therefore taxpayers, or by users, it is always individual Quebecers who will pay in the end. From this perspective, it makes more sense to consider the total costs associated with the measures proposed.

The authors of these reports used a similar approach for the measure aiming to double the supply of public transit. However, our evaluation is lower than the one presented by Équiterre and Vivre en ville, because the investments and the financing costs are amortized over the useful life of the infrastructure. As for the electrification of transportation, the implementation of a train system between major urban centres, and the high-speed rail link between Quebec City and Windsor, the environmentalist groups had not calculated the costs of these measures. Being both prudent and rigorous, we evaluate them at $2.7 billion a year.

"Although this goal is far less ambitious than that of 'liberating Quebec from oil,' the measures proposed would nonetheless entail substantial costs."

According to the calculations of Équiterre and Vivre en ville, the measures proposed would cost $5.2 billion per year, once the projects were completed. We evaluate the annual cost of these measures at $6.4 billion. To properly appreciate the magnitude of these two amounts, they represent $1,526 versus $1,875 per household, respectively.[30]

However, it is unlikely that increasing the supply of alternatives to the gasoline-powered car will lead to a corresponding increase in the demand for these alternatives (see the Technical Annex for detailed explanations). Because of this, the reduction in gasoline consumption will be less substantial than predicted, and we will not reach the expected target.

28. Équiterre, *Pour un Québec libre du pétrole en 2030*, September 25, 2009.
29. Équiterre and Vivre en Ville, *Changer de direction : Chantier aménagement du territoire et transport des personnes*, May 2011.
30. The province of Quebec had 3,395,345 households in 2011. Institut de la statistique du Québec, Ménages privés selon le genre (familiaux et non familiaux), Québec, 1951-2011, March 5, 2013.

Table 2-1
Comparison of the costs of the proposed measures (in 2013 dollars)

MEASURES		Calculations of Équiterre and Vivre en ville	Calculations of the MEI
T1-1	Doubling the supply of local public transit	$2,044,776,119	$970,548,498
T1-2	Increasing support for the use of public transit	$2,249,253,731	$1,783,515,150
T2-2	Financing the development of utility cycling infrastructure	$10,223,881	$10,223,881
T2-3	Supporting the implementation of bicycle sharing service systems across Quebec (BIXIS)	$39,668,657	$101,075,138
T5-2	Sensitizing and informing the population about sustainable transportation	$6,134,328	$6,134,328
T5-3	Supporting transportation management agencies	$8,179,104	$8,179,104
A2-3	Revising housing policy	$715,671,642	$715,671,642
A3-1	Providing technical support to municipalities	$5,111,940	$5,111,940
A3-2	Expanding financial support programs for densification and revitalization	$51,119,403	$51,119,403
A3-3	Encouraging and supporting the creation of model neighbourhoods (eco-districts)	$51,119,403	$51,119,403
Secondary objective 2.2	Electrifying private transportation	Not estimated	$789,981,500
T1-4a-4b	Setting up regional trains and high-speed rail	Not estimated	$1,874,644,958
Total		**$5,181,258,209**	**$6,367,324,945**
Total per household		**$1,526**	**$1,875**

This is why it is also important to influence the demand for gasoline by raising its price.

Doubling the Price of Gasoline

In the transportation sector, there are many reasons for the general attachment to the car, as opposed to public transit: greater comfort, greater trip flexibility, the possibility of going directly where you want to go without changing vehicles, etc.

Logically, it is highly unlikely that the residents of small municipalities would be massively drawn to local public transit, insofar as low population density would at any rate make it impossible to provide frequent enough service in several directions. In small towns, the advantages of the car are therefore even more obvious than in larger cities. For these reasons, it is difficult to replace the gasoline-powered car, whether by the electric car or by public transit.

It is possible, however, to evaluate the gas price increase that would have to be imposed on consumers in order to bring about a sure reduction in the consumption of gasoline. In short, instead of concentrating on policies related to the supply of alternatives, we can evaluate a mechanism that has a direct effect on the demand for gasoline.

In order to do this, it is important to understand which factors motivate people to own cars in the first place, as well as which factors determine how intensively they use them. Economists have been interested in these questions for some time. To understand their approach, we will first need to examine the concept of elasticity. Elasticity is a general concept that refers to the sensitivity of one variable to changes in another variable.

For purposes of illustration, if the consumption of ice cream is related to the temperature outside (the hotter it is, the more people will want to have some), we could measure the sensitivity of the consumption of ice cream to changes in temperature. If a small change in temperature leads to a large change in the consumption of ice cream, we would say that the demand for this good is very "elastic" or very sensitive to temperature variations. If the contrary is true, which is to say that a large variation in temperature causes only a small modification in the consumption of ice cream, then the demand for this product is "inelastic" or not very sensitive to changes in temperature.

One variable is particularly important as a determinant of the ownership and use of a car: the price of gasoline.[31] Logically, we should expect an increase in the price of fuel to lead users to limit their car trips or to substitute another method of transportation for car travel.

For the purpose of reducing the use of cars, as Équiterre and Vivre en ville want to do, it is therefore possible to affect the quantity demanded by modifying the price of gasoline through increased taxes. How high would the gasoline tax have to be to achieve their objectives? In order to estimate this, we need the concept of elasticity explained above.

"We evaluate the annual cost of these measures at $6.4 billion, or $1,875 per household."

The elasticity that is of interest to us here is called the price elasticity of demand. It measures the sensitivity of the quantity of a product demanded to a variation in its price. When the result of this calculation is lower than 1, then the quantity of the good demanded is considered to be insensitive to a price variation and therefore demand is rather inelastic.[32] When the result is greater than 1, then the quantity of the good demanded is rather sensitive to a price variation and demand is therefore elastic. At exactly 1, the quantity demanded varies at the same rate as price.

Over the past fifty years, hundreds of econometric studies have been carried out in numerous countries on the price elasticity of demand for fuel. There are several reasons for this strong and sustained interest: By knowing the price elasticity of demand for gasoline, we can evaluate the impact of a gasoline tax increase both on consumption and on tax revenue.

31. Other variables of course also have an influence, like the prices of vehicles, the incomes of consumers, etc.
32. By convention, and to facilitate comprehension, we are using positive rather than negative numbers.

All governments want to have an idea of the effects of these taxes on the use of automobiles, and also on their own revenues.

While there is no absolute consensus on the value of the price elasticity of demand for gasoline, and while the circumstances of the countries where these studies took place differ, economists nonetheless agree that demand is rather inelastic in this case. Recent studies found values between 0.53 and 0.6 for long-term price elasticity, which is to say over a period that is long enough for consumers to adapt to price changes.[33]

"The consumption of oil is already discouraged by several taxes levied by the various levels of government."

In order to evaluate the maximum potential impact of the proposals of Équiterre and Vivre en ville on fuel consumption, we will use 0.6 as the value for the price elasticity of demand for gasoline, which is the upper limit of the generally accepted range. This value means that a 10% increase in the price of gasoline should lead to a 6% decrease in the quantity consumed. A value of 0.5 would mean that the quantity consumed is even less sensitive to a price increase (a 10% increase in the price would then entail only a 5% decrease in the quantity consumed).

Accordingly, achieving the objective set by Équiterre and Vivre en ville, namely a 60% reduction in the consumption of gasoline for personal transportation, would require a 100% increase in the price of gasoline.[34] This would therefore require new taxes in order to raise the price of gasoline from $1.38 to $2.76 per litre.[35]

Other Measures Already in Place

As we have just seen, encouraging Canadians to reduce their consumption of oil is an expensive public policy. The proposals of environmentalist groups like Équiterre and Vivre en ville would be added to the many measures that are already in effect like gasoline taxes, British Columbia's carbon tax, Quebec's carbon market, electric car subsidies and renewable energy subsidies.

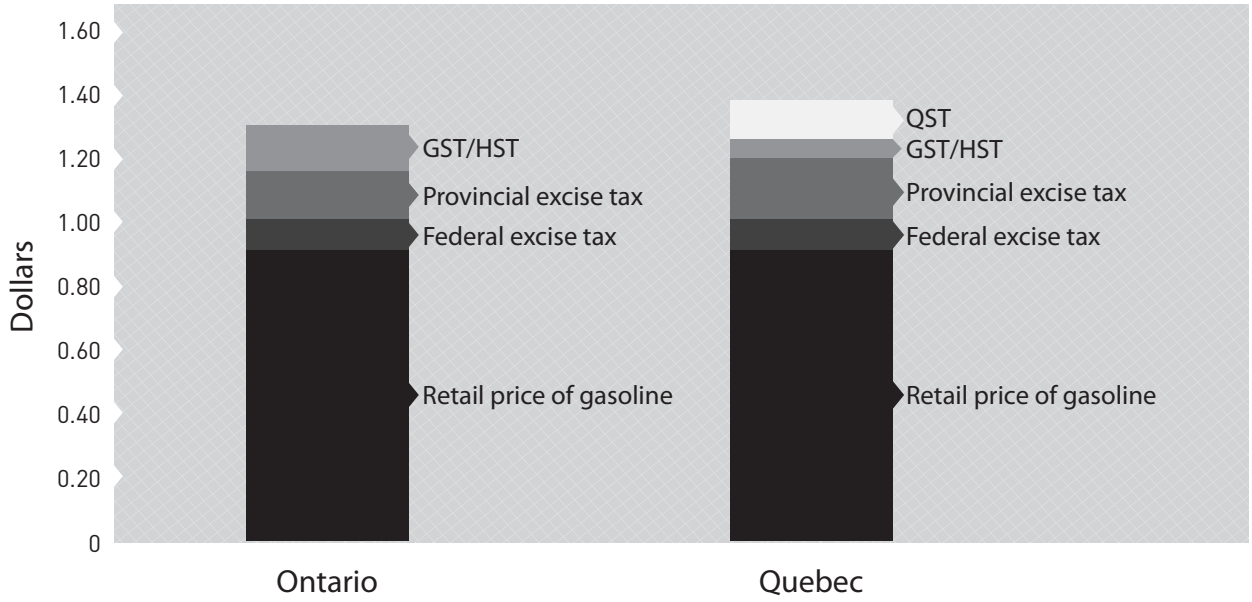
Gasoline Taxes

The consumption of oil is already discouraged by several taxes levied by the various levels of government. The federal government collected $4.3 billion from its 10¢ per litre excise tax in 2013-2014.[36] The provinces also levy excise taxes that vary from a low of 9¢ per litre in Alberta to a high of 19.2¢ per litre in Quebec.[37] To these are added a carbon tax in British Columbia, and as of January 2015, the additional cost due to the carbon market in Quebec. Finally, in the cities of Vancouver, Victoria and Montreal, a transportation tax raises the price of a litre of fuel even higher. It goes without saying that sales taxes are also applied to the sale of gasoline.

The result is that these various taxes represent a sizable proportion of the price paid at the pump, and substantial revenues for the different levels of government. As shown in Figure 2-1, when you purchase a litre of gas for $1.40, the retailer would

33. See Martijn R.E. Brons *et al.*, "A Meta-Analysis of the Price Elasticity of Gasoline Demand. A System of Equations Approach," Leibniz Information Centre for Economics, Tinbergen Institute Discussion Paper, No. 06-106/3, 2006; Molly Espey, "Gasoline Demand Revisited: An International Meta-Analysis of Elasticities," *Energy Economics*, Vol. 20, 1998, p. 277; Phil Goodwin *et al.*, "Elasticities of Road Traffic and Fuel Consumption with Respect to Price and Income: A Review," *Transport Review*, Vol. 24, No. 3, May 2004, p. 278.
34. According to theory, the marginal utility of each unit renounced should be greater than the previous one. The gasoline price increase would therefore have to be exponential in order to maintain its effect on demand and justify a reduction in consumption. However, in order to be prudent, we assume here that the marginal utility is constant, and therefore that the price elasticity is as well. This underestimates the real value of the price increase required to achieve the objective proposed by Équiterre and Vivre en ville. Therefore, the price increase required for a reduction as draconian as their 60% objective would be much higher than the one proposed in this chapter.
35. The cost of $1.38 per litre is based on an average of the most recent data available (from January to October 2014). Régie de l'énergie du Québec, Essence ordinaire PRIX MOYEN AFFICHÉ, p. 6.
36. Government of Canada, *Public Accounts of Canada 2014, Volume I: Summary Report and Consolidated Financial Statements*, October 2014, p. 3.4.
37. Natural Resources Canada, *Fuel Focus: 2013 Annual Review*, January 17, 2014, p. 6.

Figure 2-1
Breakdown of the price of a litre of gasoline



Source: Natural Resources Canada, *Fuel Focus: 2013 Annual Review*, January 17, 2014, p. 6.

be ready to sell it to you for 92¢ in Quebec (outside of Montreal). The additional 48¢ of taxes make up 34.3% of the retail price of gasoline. For an Ontarian under the same market conditions, a litre of gasoline will cost $1.32, with taxes representing 30.2% of the price.

The Carbon Tax and the Carbon Market

British Columbia is the only province to have adopted a carbon tax. Phased in from 2008 to 2012, this tax, equivalent to $30 per tonne of GHGs, generated $1.2 billion in tax revenue for 2013-2014. The government has reduced personal and corporate income taxes while also offering various more specific credits in order to maintain the revenue neutrality of this carbon tax.[38]

At $30 per tonne of GHGs, the effect of the carbon tax on the daily lives of British Columbians is that they have to pay an additional 6.67¢ per litre of gasoline, 7.67¢ per litre of diesel and 5.70¢ per cubic metre of natural gas. It only applies to fuels.[39] Since the carbon tax was put in place, the consumption of taxed fuels has indeed fallen.[40]

"Imports are not 'bad,' any more than exports are 'good.'"

Within the context of the public debate on the reduction of oil consumption, the carbon tax has the advantage of being revenue neutral. The British Columbian government is influencing the consumption of oil downward by modifying the price signal, but it is also trying to avoid the most serious economic repercussions by lowering other components of

38. Ministry of Finance of British Columbia, *Budget and Fiscal Plan 2014/15 – 2016/17*, February 2014, p. 64.

39. Ministry of Finance of British Columbia, How the Carbon Tax Works.

40. Stewart Elgie and Jessica McClay, "BC's Carbon Tax Shift after Five Years: Results," Sustainable Prosperity, University of Ottawa, July 2013, pp. 2-4.

taxation. Of course, these other reductions are the results of political decisions, influenced by considerations other than economic impact. Still, the results already obtained in British Columbia in terms of reducing oil consumption did not require any new government program or new tax revenue.

Quebec, for its part, decided to establish a carbon market with California, which will have the effect of adding a cost, equivalent to another tax, to the price of gasoline as of January 2015. This cap-and-trade system for GHG emission permits will generate revenues for the provincial government's Green Fund for the purpose of financing initiatives to reduce GHGs.[41] The sale of GHG emission permits should bring in around $500 million a year for the Quebec government.[42]

"Several Canadian provinces have either attempted or are attempting to promote the purchase of electric vehicles, through such measures as subsidy and tax credit programs."

This mechanism, just like a carbon tax, promotes the reduction of fuel consumption. However, because the carbon market is not revenue neutral, its economic impact will in all likelihood be heavier.

The other Canadian provinces have not adopted similar mechanisms to reduce oil consumption. More targeted initiatives exist, like the $15 levy per tonne of GHGs charged to large emitters by the Alberta government.[43] The idea of a carbon tax was nonetheless a topic of debate during the federal election campaign in the fall of 2008, but the Liberal Party of Canada that proposed it did not end up forming the government.[44]

Subsidies for Electric Vehicles and Green Energy

In addition to gasoline taxes and carbon taxes, which have similar effects, certain public policies aim instead to substitute "green" options for the consumption of fossil fuels. Several Canadian provinces have either attempted or are attempting to promote the purchase of electric vehicles, through such measures as subsidy and tax credit programs.[45] These rebates are focused primarily on the purchase of fully electric cars, rechargeable hybrids and the equipment required to fuel these cars, namely charging stations.

Currently, Ontario and Quebec subsidize the purchase of electric vehicles, whereas British Columbia ended its program in March of this year. Prince Edward Island had for its part opted for a provincial tax credit, but it expired in April 2013.[46]

The subsidies that are offered are motivated in large part by reduction targets for greenhouse gases and the consumption of petroleum products. In Canada, the transportation sector emits nearly a quarter (24%) of all GHG emissions.[47] However, such public policies are very ineffective, and the cost of GHG emissions avoided in this way is very high.[48]

When it comes to subsidizing renewable energy, here as well, the results of the subsidies awarded are disappointing and come at a high economic price. Whether through the use of "feed-in tariffs" in Ontario or the purchase of wind power in Quebec, provincial governments subsidize renewable energy producers, even though this energy does not necessarily replace electricity production that is polluting. In the case of wind turbines in Quebec, for example, the purchase of electricity production at a

41. Department of Sustainable Development, Environment and the Fight against Climate Change, Le système québécois de plafonnement et d'échange de droits d'émission : En bref.
42. Pierre-Olivier Pineau, "Où vont aller les milliards du Fonds vert?" *La Presse*, June 5, 2014.
43. Martin Croteau, "Plan vert en Alberta : les écologistes ne crient pas victoire," *La Presse*, September 19, 2014.
44. "Carbon tax plan 'good for the wallet,' Dion pledges," CBC News, June 19, 2008.
45. Canadian Automobile Association, Government Incentives.
46. Government of British Columbia, Transportation Rebates and Incentives; Government of Quebec, Running on Green Power!; Ontario Ministry of Transportation, Cars are EVolving; Prince Edward Island, Revenue Tax (PST) Refund.
47. Data for 2012. Environment Canada, "National Inventory Report 1990-2012: Greenhouse Gas Sources and Sinks in Canada — Executive Summary," June 2014, p. 8.
48. Youri Chassin in collaboration with Guillaume Tremblay, "Do We Need to Subsidize the Purchase of Electric Cars?" *Economic Note*, Montreal Economic Institute, November 2014.

guaranteed price puts Hydro-Québec in a situation in which it must pay out $695 million a year on average for energy that, thanks to its energy surpluses, it does not need.[49]

The case of biofuels, primarily ethanol-based, is also worth examining. All around the world, including in the United States, Brazil and the European Union, governments support the production of ethanol with a view to reducing their "dependence" on oil.[50] This encouragement takes two forms: requiring gasoline producers to incorporate a certain percentage of ethanol into their fuels and subsidizing ethanol producers. The official objectives are generally to reduce dependence on imported oil and to replace a portion of fossil fuels with renewable fuels.

However, these subsidies are very expensive and require governments to increase taxes, reduce other expenditures or run deficits. These policies have also contributed to rising international cereal prices (for corn and wheat, among others) and to rising global food insecurity because of the diversion of these foodstuffs for the production of fuel. Finally, it is far from a proven fact that ethanol production is efficient, either environmentally or energetically. On the contrary, certain studies show that its environmental and energetic effects may be negative.[51]

Does Reducing Imports Save Money?

Could the extra costs entailed by these policies at least be offset by generating savings elsewhere or by stimulating investment and employment?

In their document, the two environmentalist groups, Équiterre and Vivre en ville, claim that their proposals would reduce Quebec's trade deficit since oil and automobiles are the province's top two imports.[52] According to them, reducing imports from abroad would amount to an economic benefit for Quebec.

This kind of mercantilist argument, although it has been dismantled time and again, is worth a brief pause here because it comes up frequently in public debates.[53] Imports are exchanges carried out with foreign entities, and like all voluntary exchanges, they can only occur if both parties see them as beneficial. The dollars that we "export" by purchasing goods and services from people in other countries allow foreigners in turn to buy goods and services that they need, so that these dollars are then "reimported." Imports are therefore not "bad," any more than exports are "good."

"Thinking that there are savings to be had by doing without a product whose consumption increases well-being and productivity amounts to suggesting that we should all fast in order to save on our grocery bills."

In other words, the refinery located in Quebec that buys a certain quantity of Algerian oil believes that it will benefit from this exchange and that this will allow it to earn profits. Similarly, a worker who drives to work judges that he or she is better off doing so than staying home to save on gas. In each case, economic activity in Quebec increases. In a context of free trade, commercial flows are not determined by the nationality of clients and suppliers, but by the profitability of purchases and contracts.

49. Youri Chassin in collaboration with Guillaume Tremblay, *op. cit*., footnote 23.
50. Tim Josling *et al*., "Biofuel and Biomass Subsidies in the U.S., EU and Brazil: Towards a Transparent System of Notification," International Food & Agricultural Trade Policy Council, September 2010, pp. 6-9.
51. Kiran Bhat, "Misplaced Priorities: Ethanol Promotion and Its Unintended Consequences," *Harvard International Review*, 2008, pp. 30-33; Emma Hutchinson *et al*., "Subsidies for the Production of Cleaner Energy: When Do They Cause Emissions to Rise?" *Journal of Economic Analysis & Policy*, Vol. 10, No. 1, 2010, p. 6; Madhu Khanna *et al*., "Welfare Effects and Unintended Consequences of Ethanol Subsidies," *Review of Agricultural Economics*, Vol. 30, No. 3, January 2008, pp. 411-421.
52. Équiterre and Vivre en Ville, Annexe, p. 15.
53. Mercantilism was the dominant economic theory in the 17th and 18th centuries. It advocated limiting imports and restricting capital outflows across national borders. Today, mercantilism instead takes the form of economic nationalism and protectionism whose theories are based on similar reasoning. François Quesnay (1694-1774), Adam Smith (1723-1790) and David Ricardo (1772-1823) in particular were instrumental in deconstructing the erroneous economic concepts of mercantilism.

Équiterre and Vivre en ville maintain that their proposals favour the emergence of alternatives to the use of oil in transportation. Yet these other options are already possible, and the fact that they are not widely embraced shows that the current situation is deemed more advantageous by Quebecers. If they were forced to adopt other, more expensive forms of transportation, they might consume less imported oil, but they would also end up losing other benefits they value more, entailing a loss of well-being. By restricting consumers' decisions, the proposals of Équiterre and Vivre en ville would force the adoption of more expensive transportation solutions offering fewer benefits. Any way you look at it, even if oil imports fall, this can only represent an impoverishment.

"Making an investment whose net present value is negative means taking resources that have a high value and transforming them into goods and services that are of lesser value."

Thinking that there are savings to be had by doing without a product whose consumption increases well-being and productivity amounts to suggesting that we should all fast in order to save on our grocery bills. Clearly, this kind of policy would have dire consequences before long.

How Does One Evaluate an Investment?

Despite the failure of subsidies both environmentally and economically, some remain convinced that they are worthwhile because they supposedly encourage technological progress within these industries as well as the creation of "green" jobs. Therefore, whatever the costs related to public transit investments and spending, to the electrification of transportation and other "green" projects, these projects are justified by maintaining that although they are expensive, they lead to the creation of green jobs with high added value.

To correctly analyze this matter, we must return to some of the most fundamental questions in economics regarding the allocation of resources: What should we produce? Which kinds of production will best increase the well-being of everyone in society? In which projects should businesses invest?

A company invests in order to generate profits. This profit motive in turn generates benefits for society as a whole. Indeed, if a company's investment is profitable, this means that it produces goods and services whose value is greater than the value of all of the resources (labour, raw materials and physical capital) used to produce them. By only making profitable investments, the company therefore contributes to the maximization of well-being in society.

In order to know whether or not an investment generates profits, a company calculates the "net present value" of its project, which is to say the current value of the sums of money that will be spent and received over the lifetime of the investment. The net present value is the criterion that allows us to distinguish investments that create value and well-being from those that destroy value. Making an investment whose net present value is negative means taking resources that have a high value and transforming them into goods and services that are of lesser value. It is the equivalent of using filet mignon (a high-value resource) to make shepherd's pie (a low-value good in consumers' eyes). In any field of endeavour, this is a waste.

Are Green Investments Different?

The justification for green investments often rests on environmental externalities. An externality is something that is produced when a given action (production or consumption) affects the well-being of a third party, which is to say someone who is not directly involved in this activity. An externality is positive if the well-being of third parties is improved. It is therefore in the interests of society as a whole for this activity to be more widespread.

An externality is negative if the action causes the well-being of third parties to deteriorate. The most obvious case is pollution. A company that pollutes while it produces takes into account, in its

decision-making process, its own production costs and the income received from the sale of its products, but not the cost that third parties bear for the pollution it generates. From the perspective of the optimal level of well-being in a society, we may therefore produce too much and pollute too much.

Government regulation can provide a solution to these problems. Green taxes in the case of negative externalities, and subsidies in the case of positive externalities, are other ways of getting people to take into account the costs or the benefits that their activities entail for third parties. It is of course essential, though, to correctly measure the value of externalities in order to adjust those taxes and subsidies and to ensure that those regulations are efficient and necessary.[54]

"The concept of economic spinoffs completely obscures the fact that the expenditures in question will necessarily be offset by less spending elsewhere."

How do green investments measure up? Once we have judiciously taxed activities that pollute or subsidized activities with external benefits in order to get people to take into account the effects of their choices on third parties, green investments are no different from other kinds of investments. Those that are efficient and worth undertaking will generate positive net present values and will be started. The others will not be carried out.

Developers of green investment projects who request financial commitments from governments sometimes also rely on talk of economic spinoffs, which is to say the total expenditures that are generated by an initial amount of spending. However, the concept of economic spinoffs does not really make sense when it comes to public spending.[55] Indeed, it completely obscures the fact that the expenditures in question will necessarily be offset by less spending elsewhere. What a government spends, it must raise through taxation. Taxpayers will therefore have less money and will spend less, which entails negative spinoffs that are at least equivalent to the positive direct spinoffs.

Are the Proposals of Équiterre and Vivre en Ville Good Investments?

Équiterre and Vivre en ville have not subjected their proposals to an analysis like the calculation of net present value. We can imagine that these projects generate negative net present values because of the substantial government subsidies required to finance them. For example, without public subsidies, interregional trains and bicycle sharing systems would go bankrupt. As for the new projects, if their net present values were positive, private developers would probably be interested anyway, which has not been the case thus far.

These projects nevertheless do have the benefit of reducing the negative externalities associated with GHG emissions. This benefit must be taken into account. However, the reduction of GHG emissions associated with the measure that aims to double the supply of public transit in Quebec amounts to 266,500 tonnes a year at a cost of $2.75 billion, which means $10,300 per tonne of GHGs avoided. Given that the price of a tonne of GHGs is $11.39 on the carbon market,[56] we could achieve the same result for $3 million (therefore about 1/1000 of the cost) by using the carbon market.

What about Green Jobs?

Some will say that green investments create green jobs and that we have to take these benefits into account. Surprisingly, it is not easy to define the concept of a green job. Very often, developers of so-called green projects include all the jobs created by their projects: factory maintenance personnel, administrative and accounting staff, etc. These are the

54. This is assuming that the government is not motivated by political considerations, but rather by the goal of maximizing societal well-being.
55. See Yvan Stringer and Jacques Raynauld, "Le problème allocatif," Chapter 4, in *Problèmes et politiques économiques : 2e édition*, ERPI, April 2008.
56. California Air Resources Board and Department of Sustainable Development, Environment and the Fight against Climate Change, "Avis sur le prix minimum d'une vente aux enchères CA-QC," September 2014, p. 1.

same jobs that exist in the company next door that has not received the "green" label.

Even if we accept the definition of green jobs proposed by the developers of these projects, which means including all the jobs created by them, we must not forget to take opportunity costs into account. When a subsidy is granted to support a green investment, the population will have to be taxed sooner or later. These new taxes reduce the disposable income of households, which then spend less. Certain businesses in turn produce less, and employment is therefore reduced elsewhere in the economy. The creation of green jobs therefore corresponds to the destruction of "regular" jobs.[57]

What do we know about the net effect of subsidy policies for the transition to renewable energy? No studies on this topic have been carried out in Quebec, but an examination of the value of the subsidies per job created allows us to form a rough idea; if the subsidy per job is very high, we can presume that each green job created will displace more than one regular job.

"The capital diverted to support a green job would have maintained or created 2.2 jobs in the rest of the economy."

In Ontario, a study by the C.D. Howe Institute estimates that subsidies to the production of electricity from renewable sources represent an annual cost of $179,760 per job.[58] Given the fact that total remuneration in Ontario averages $55,945, each job created in this sector was created at the cost of 3.2 jobs in the economy as a whole.

In Spain, according to a study by the Universidad Rey Juan Carlos, each green job[59] created by the government costs on average $781,400 in subsidies, and even $1.4 million per job specifically in the wind sector. By dividing the annual subsidy of $76,500 required to maintain or create a green job by the average productivity of an employee in the rest of the economy, which is $34,700, the authors estimate that the capital diverted to support a green job would have maintained or created 2.2 jobs in the rest of the economy.[60]

According to a study carried out by the Bruno Leoni Institute, the same phenomenon can be observed in Italy. To create or maintain a green job,[61] it is estimated that $1.1 million of capital must be invested on average. Compared to the capital required for a job in the overall economy, which amounts to $233,300, the authors conclude that the diversion of capital to create one green job using government subsidies comes at a cost of 4.8 jobs elsewhere.[62]

In Germany, the Institute for Energy Research calculated in 2009 that each green job created in that country cost up to $240,000 in subsidies. The institute wrote:

> It is most likely that whatever jobs are created by renewable energy promotion would vanish as soon as government support is terminated, leaving only Germany's export sector to benefit from the possible continuation of renewables support in other countries such as the US.[63]

In other words, these green jobs disappear as soon as the subsidies dry up. As for statements to the effect that Quebec could become a green energy leader if the government subsidized the transition to renewable energy sources, here is what this same institute had to say in the case of Germany:

> Claims about technological innovation benefits of Germany's first-actor status are

57. The theoretical argument regarding green jobs is based on the following work: Pierre Lemieux, *Who Needs Jobs? Spreading Poverty or Increasing Welfare*, Palgrave MacMillan, 2014.
58. Benjamin Dachis and Jan Carr, "Zapped: The High Cost of Ontario's Renewable Electricity Subsidies," C.D. Howe Institute, May 2011, p. 5.
59. The authors are here referring to the wind, solar and hydroelectric sectors.
60. Gabriel Calzada Álvarez *et al.*, *Study of the Effects on Employment of Public Aid to Renewable Energy Sources*, Universidad Rey Juan Carlos, March 2009, pp. 25, 26 and 29; Bank of Canada, *Year Average of Exchange Rates (Average of 250 Days)*, Financial Markets Department, 2013.
61. These are in the wind and solar sectors.
62. Luciano Lavecchia and Carlo Stagnaro, "Are Green Jobs Real Jobs? The Case of Italy," Istituto Bruno Leoni, May 2010, p. 38.
63. Manuel Frondel *et al.*, "Economic Impacts from the Promotion of Renewable Energies: The German Experience," Rheinisch-Westfälisches Institut für Wirtschaft sforschung, October 2009, pp. 24-25.

> unsupportable. In fact, the regime appears to be counterproductive in that respect, stifling innovation by encouraging producers to lock into existing technologies.[64]

In short, while there has been no exhaustive study of the employment effects of the projects proposed by Équiterre and Vivre en ville, we can safely assume that they would not create more jobs than they destroyed elsewhere in the economy, just like subsidized projects elsewhere on the planet.

64. *Ibid.*, p. 7.

CHAPTER 3

How Much Are Canadians Willing to Pay?

While modest, the objectives analyzed in the preceding chapter for promoting the use of public transit and reducing gasoline consumption entail significant sacrifices on the part of Canadians. Are they prepared to make these sacrifices to fight climate change? Would they be willing to pay $1,875 per household or to accept a doubling of the price of gasoline in order to reduce total oil consumption by 20%?

Previous Surveys on the Fight against Climate Change

There is no doubt that the Canadian population is concerned about climate change. In a poll carried out this past March, 45% of respondents said they were somewhat concerned and 32% very concerned by this phenomenon.[65] As part of a possible national energy strategy, over 60% of Canadians considered the reduction of our "reliance on oil" and of our GHG emissions to slow down climate change as a high priority.[66]

These observations let it be understood that Canadians would be inclined to take financial responsibility for measures aiming to reduce GHG emissions and promote renewable energy. Yet when polled about the financial sacrifices they would be prepared to make, respondents proved very reticent to pay even modest sums in order to pursue these objectives.

Regarding the costs related to a possible carbon tax, only a slim majority of Canadians were in favour, even if their energy bills ended up increasing by just $15 per month.[67] As for the additional amount Canadians would be prepared to pay to encourage the production of renewable energy, 18% said they did not want to pay a penny more and 65% admitted they were willing to pay less than $100 a year. Only 4% of Canadians would want to support the production of renewable energy at an annual cost of $500 or more.[68]

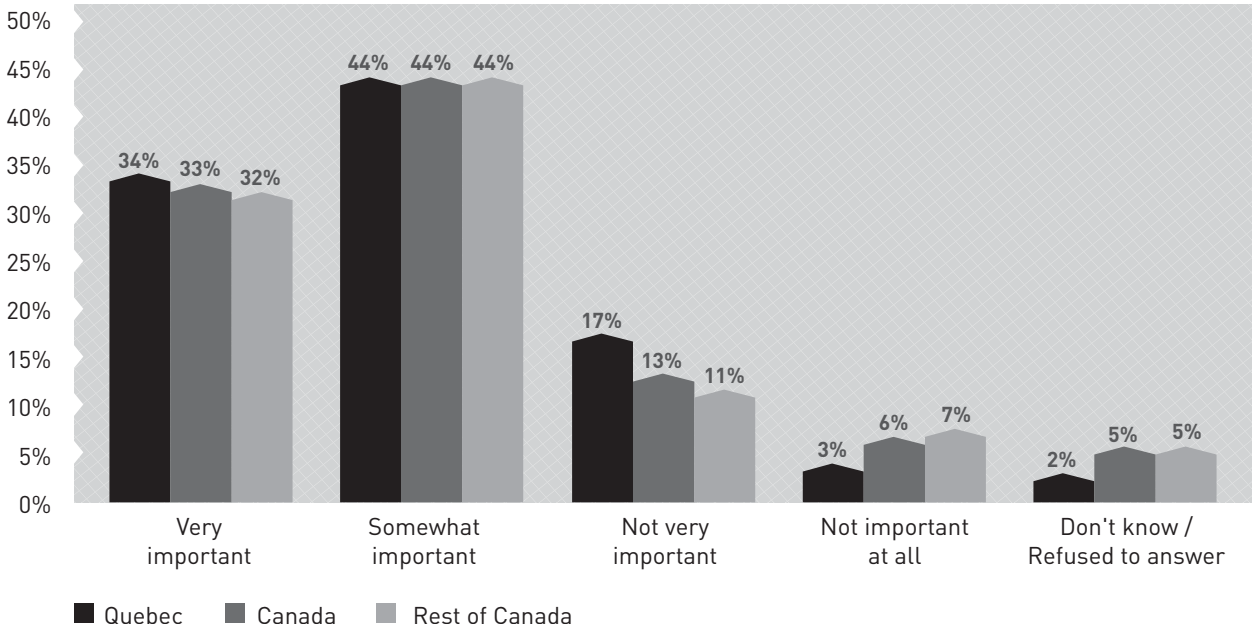
Clearly, measures whose costs are not mentioned seem a lot more popular in surveys than those that entail an explicit monetary impact. For example, in Quebec, over 80% of the population is in favour of tax credits for the purchase of green vehicles, to the introduction of high-speed rail and tram systems, to the electrification of buses, to increasing the amount of public transit available and to the development of densified neighbourhoods. On the other hand, 80% of respondents are somewhat or very opposed to increasing taxes on oil and 70% are somewhat or very opposed to the introduction of a tax on the purchase of a gasoline-powered vehicle.[69]

"There is no doubt that the Canadian population is concerned about climate change."

The importance placed on environmental issues also includes an economic aspect since 54% of Canadians admit to adopting habits of energy conservation at home more in order to reduce their energy bills than for strictly environmental reasons.[70] Furthermore, among the issues of interest to Canadians in the next federal election, the environment is ranked 6th out of 8, behind issues like health care, education and the economy.[71]

65. Erick Lachapelle *et al.*, "2013 Canada-US Comparative Climate Opinion Survey," Canada 2020, March 2014, p. 7.
66. Poll carried out by Harris/Decima on behalf of Clean Energy Canada (Tides Canada), *Canadians' Priorities for a Canadian Energy Strategy*, July 2013.
67. Etienne Leblanc, "Sondage Léger : Harper doit en faire plus contre le réchauffement climatique," Radio-Canada, November 6, 2014.
68. Erick Lachapelle *et al.*, *op. cit.*, footnote 65, p. 14.
69. CROP, "Perception des Québécois à l'égard des questions énergétiques," Poll commissioned by the Regroupement national des conseils régionaux de l'environnement du Québec and the Institut du nouveau monde, September 2010, p. 53.
70. "Survey finds Canadians more concerned with saving green than being green," Poll commissioned by Centennial College's School of Engineering Technology and Applied Science, April 3, 2014.
71. Daniel Thibeault, "Les libéraux de Justin Trudeau en tête dans les intentions de vote," Radio-Canada, October 19, 2014.

Figure 3-1
Importance placed on the fight against climate change



Source: Léger, "Study of Canadians' Level of Support for Measures to Reduce Oil Consumption," Poll commissioned by the Montreal Economic Institute, November 2014.

The issue of reducing the use of fossil fuels in favour of renewable energy sources does not enjoy the same level of support in each province. While 81% of Quebecers believe that this is possible for their province, this level falls to just 52% in Alberta.[72]

"When polled about the financial sacrifices they would be prepared to make, respondents proved very reticent to pay even modest sums in order to pursue these objectives."

Regarding increasing international efforts to fight climate change, Quebec stands out with 73% support, versus 63% for Canada as a whole. The level of support is just 54% in Manitoba and Saskatchewan. With only 43% support, the population of Alberta is the least inclined to support increased international efforts to fight climate change.[73]

This brief overview of polls on climate issues and the consumption of oil shows the wide gap that exists in the Canadian population between support for certain goals and support for certain proposed measures for achieving those goals. Despite the fact that the majority of Canadians say they are concerned about climate change, this proportion falls considerably when the cost associated with these measures is mentioned.

The Results of the Léger Poll

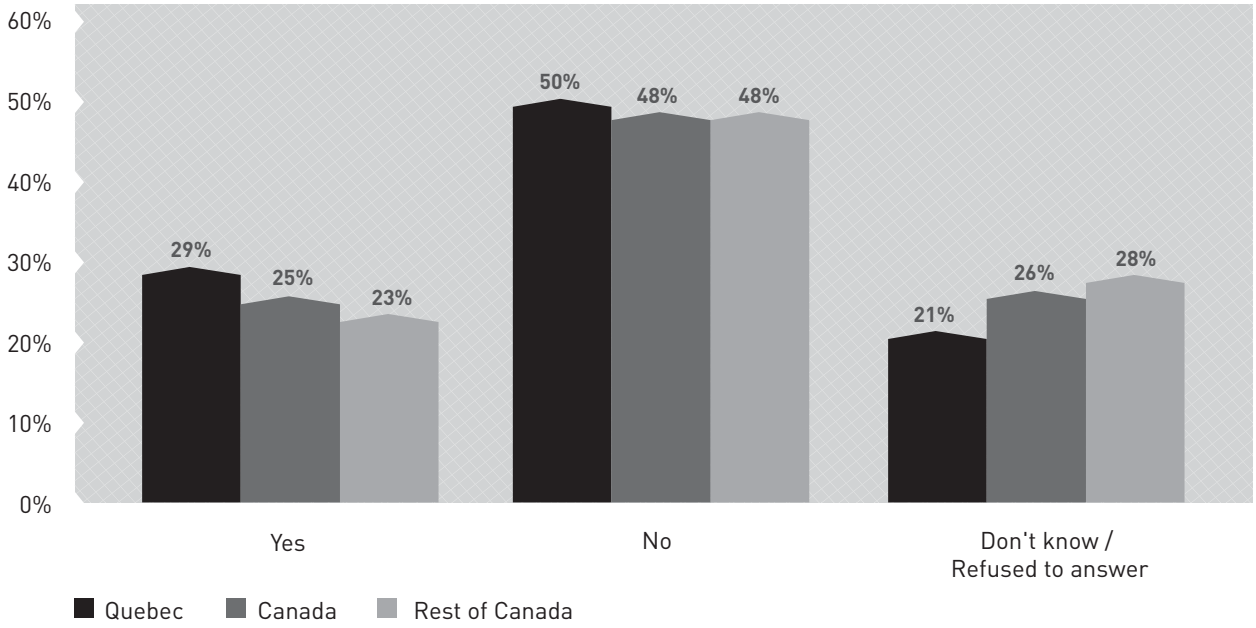
In October 2014, the MEI commissioned Léger[74] to poll the opinions of Canadians regarding the costs

72. Environics Institute for Survey Research and David Suzuki Foundation, "Canadian public opinion about climate change," 2013, pp. 5-6.

73. Martin LaSalle, "Les changements climatiques sont une priorité pour les Canadiens," *Journal Forum*, Université de Montréal, November 18, 2013.

74. Léger, "Study of Canadians' Level of Support for Measures to Reduce Oil Consumption," Poll commissioned by the Montreal Economic Institute, November 2014.

Figure 3-2
Willingness of households to pay more to reduce oil consumption by 25%



Source: Léger, "Study of Canadians' Level of Support for Measures to Reduce Oil Consumption," Poll commissioned by the Montreal Economic Institute, November 2014.

of the measures to put in place in order to reduce oil consumption. This poll was carried out from October 27 to 30, 2014, with a sample of 2,143 Canadians aged 18 or older who could express themselves in English or French. Among the respondents, 1,024 lived in Quebec and 1,119 lived elsewhere in Canada. With the help of data from Statistics Canada, in order to make the sample representative of the population studied, the results were weighted according to gender, age, region, level of education, and the presence or lack of children in the household.

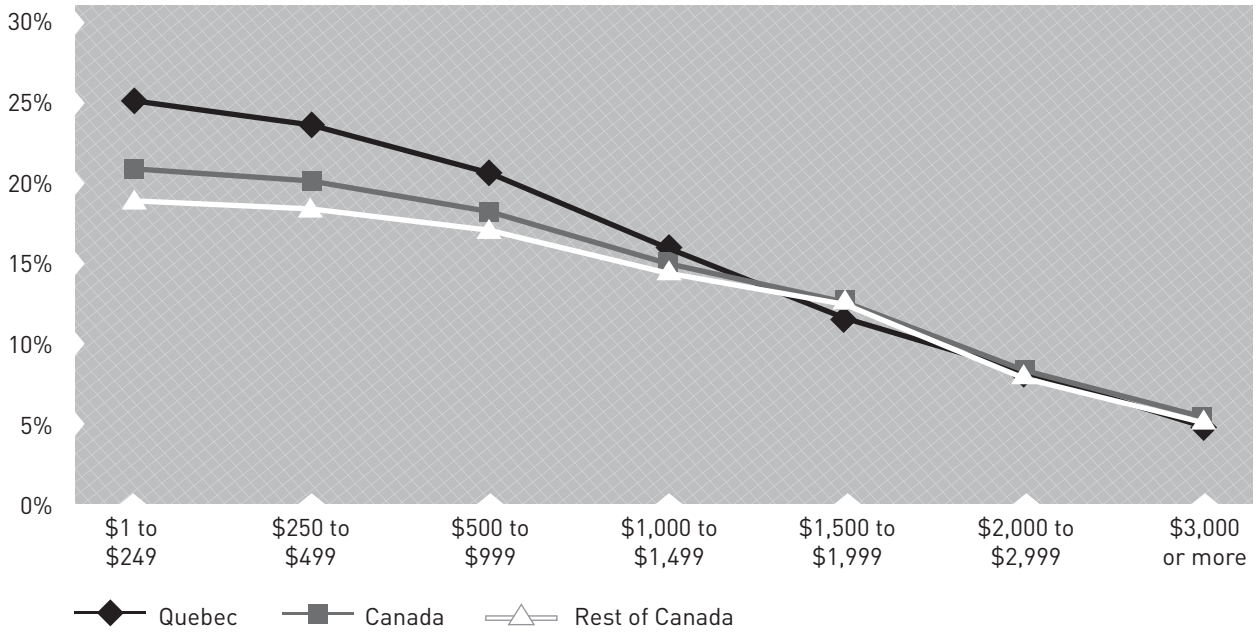
"Only 29% of Quebecers and 23% of Canadians from the rest of the country are in favour of having their family pay more."

One striking result concerns the importance placed on the fight against climate change. A clear majority of the population, namely 78% of Quebec residents and 76% of residents of the rest of Canada, think the fight against climate change is important,[75] while one in five people place little or no importance on this issue. Around 5% of respondents did not express an opinion (see Figure 3-1). The opinion of Quebecers is therefore similar to that of other Canadians on the subject of fighting climate change.

To a question on the willingness to pay more in order to reach the objective of reducing the consumption of oil by 25%,[76] respondents' opinions are more nuanced. Only 29% of Quebecers and 23% of Canadians from the rest of the country are in favour of having their family pay more, while 50% of Quebecers and 48% of other Canadians are opposed. Substantial proportions of respondents did not express an opinion: 21% in Quebec and 28% elsewhere in Canada (see Figure 3-2). This illustrates that it is easier to be in favour of the fight against climate change than to make personal, concrete sacrifices.

75. Includes somewhat and very important.
76. According to our calculations, the adoption of the measures proposed by Équiterre and Vivre en ville would lead to a 20% reduction in total oil consumption. To be prudent, the wording of the question refers to 25%.

Figure 3-3
Amount that households are willing to pay per year to reduce oil consumption by 25%



Source: Léger, "Study of Canadians' Level of Support for Measures to Reduce Oil Consumption," Poll commissioned by the Montreal Economic Institute, November 2014. **Note:** The percentage represents the proportion of respondents in favour of the proposed increases.

We should also note that car owners and middle class families are more likely to be against the idea of paying more, while people who do not own cars are more inclined to be in favour.

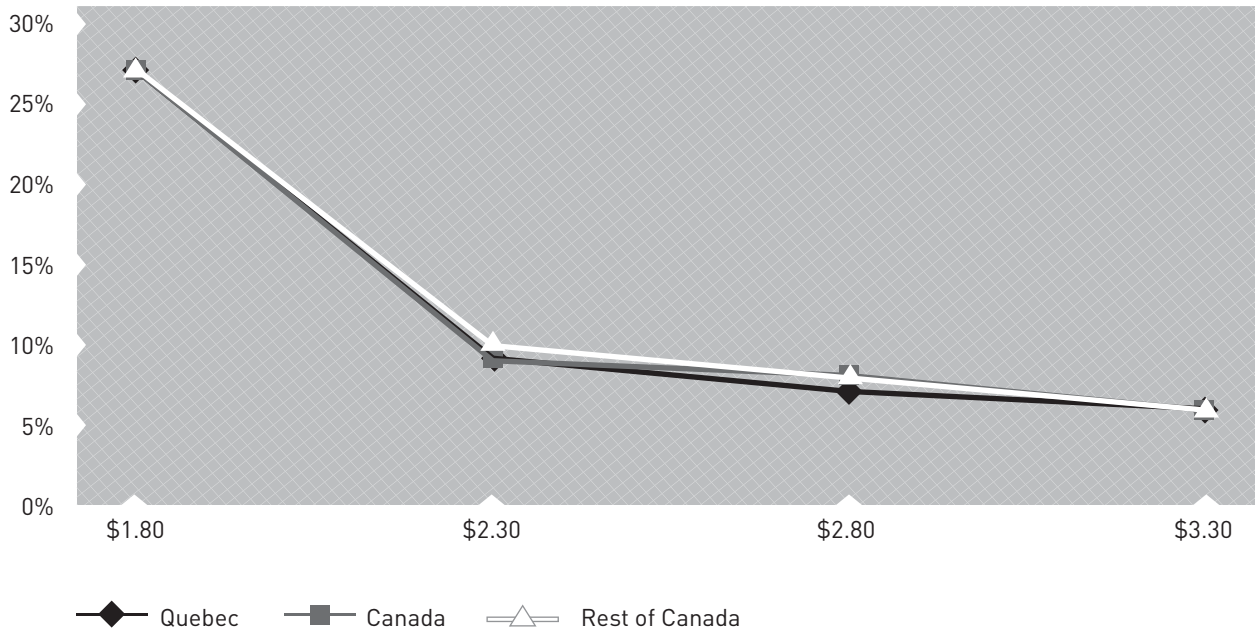
"Barely 7% of Quebec respondents would be willing to accept a doubling of the price of gasoline in order to reduce total oil consumption."

When the magnitude of the sacrifices required is specified in the poll questions, even more Canadians and Quebecers are opposed to additional expenses to reduce oil consumption. At an annual cost of between $1 and $249, only 25% of Quebecers are willing to pay, a figure that is just 21% in the rest of the country. Barely 5% of Quebecers are willing to pay $3,000 or more per year to reach the goal of reducing gasoline consumption. It is interesting to note, moreover, that as the amount increases, the proportion of Quebecers willing to pay goes from above the Canadian average to below it, despite the fact that Quebecers place greater importance on the fight against climate change (see Figure 3-3).

It is worth remembering that the cost estimated by the MEI for the measures proposed by Équiterre and Vivre en ville amounts to $1,875 per household per year. The poll indicates that only 12% of Quebecers would be in favour of taking on this level of additional expense.

In summary, although nearly 80% of Canadians say that fighting climate change is important, only 25% would accept to pay more to reach the objectives of Équiterre and Vivre en ville. Among these, only a small proportion would be willing to pay a considerable sum. We have to limit ourselves to less than $500 a year per household on average, or less than $1.40 a day, to obtain the support of 20% of Canadians. A good proportion of respondents

Figure 3-4
Acceptability of select price increases for a litre of gasoline for the purpose of reducing oil consumption



Source: Léger, "Study of Canadians' Level of Support for Measures to Reduce Oil Consumption," Poll commissioned by the Montreal Economic Institute, November 2014. **Note:** The percentage represents the proportion of respondents in favour of these prices following a tax increase.

therefore deem that this is an important issue, but without being willing to devote any money to it.

We examined in the previous chapter, using the concept of elasticity, the gasoline price increase that would be required in order to get car drivers to reduce their consumption of gasoline by 60%. Doubling the price of gasoline would allow this goal to be reached, in the absence of other measures. The Léger poll examines the potential reaction of consumers in Quebec and in the rest of the country.

Barely 7% of Quebec respondents would be willing to accept a doubling of the price of gasoline in order to reduce total oil consumption. The proportion is similar, at 8%, for the rest of Canada (see Figure 3-4). Note that, among those most inclined to accept a gas price increase, people who don't own a car are heavily overrepresented.

In order to reduce oil consumption substantially, but without liberating ourselves from it, it would therefore be necessary to put in place policies that the great majority of Quebecers and other Canadians do not want. Furthermore, as was shown previously, we have no guarantee that these policies would achieve their objectives. Like the other polls discussed, our survey shows that the majority of Canadians support the idea of reducing oil consumption in general, but without being willing to make the sacrifices required to achieve reduction targets.

CONCLUSION

As we saw in the first chapter of this Research Paper, oil is a natural resource that is and will remain very present in modern economies, including Canada's. The petrochemical sector produces plastics, as well as many other materials that are difficult to replace. Oil is the primary energy used for transportation and will remain so until technology allows other energy sources to be more competitive.

Of course, oil is a non-renewable resource, but we are not threatened with any imminent shortage pressuring us to find alternatives. On the contrary, proven reserves, which represented 30 years of consumption in 1980, now guarantee over 53 years of future consumption.

For environmental reasons, though, it would be good to reduce oil consumption. Indeed, over three quarters of Canadians polled by Léger think fighting climate change is important. On the other hand, accelerating the transition to other energy sources is no simple matter and may even be unrealistic.

Just as the world largely moved from coal to oil over the past century, we will eventually move to other forms of energy thanks to technological innovation. Note that even though coal is no longer as important as it was during our great-grandparents' generation, it nonetheless still represents 30% of the primary energy used on the planet. Like all major economic transformations, energy transitions do not happen overnight. If we try to force this transition through so-called "green" coercive policies, without waiting for technology and time to lower costs, we have to be prepared for a hefty bill.

Équiterre and Vivre en ville propose a set of measures that would profoundly affect our daily lives. These measures have costs, some of which are measurable. When we consider certain of these policies that are amenable to cost evaluation, we realize that reducing oil consumption is far from being a free exercise. According to our evaluation, the measures identified by these two environmentalist groups would cost Quebecers $6.4 billion a year, or a little more than $1,875 per household. In terms of the environmental impact for Quebec, total oil consumption would be reduced by at most 20%, despite the magnitude of the sums in play, and GHG emissions would fall by just 12%.

According to a Léger poll, Canadians are not prepared to make this extra effort. Both in Quebec and in the rest of Canada, barely 12% of respondents would be willing to accept such an expense. Even for a much less ambitious program, one that would for instance cost less than $500 a year per household, barely one in five Canadians says they are willing to pay such an amount to reduce oil consumption by 25%.

Knowing that the measures proposed by Équiterre and Vivre en ville will in all likelihood not reach their objective of reducing gasoline consumption, an increase in the price of gasoline would undoubtedly also be essential. However, such a solution faces a veritable wall of opposition. Barely 7% of Quebecers and 8% of other Canadians would accept raising the price of gasoline to $2.80 per litre in order to achieve this objective, which is probably the price that would be required to bring about the desired radical change.

Like many other topics discussed in public debates, climate change represents, for the vast majority of Canadians, an important challenge to be addressed. We must understand, though, that public policy choices entail trade-offs: If we want to achieve certain objectives, we will have to give up other things. In the case under consideration here, the costs are considerable. As explained in Chapter 2, neither are these costs offset by advantages stemming from economic spillover or the creation of "green" jobs.

However the bill is divided up, it will ultimately by paid by all Quebecers and Canadians. It could take the form of a heavier tax burden or extra fees, or else of a reduction in public spending in other areas like health care and education. The effect these policies would have in terms of increasing the costs of production and transportation, which would eventually be passed on to consumers in the form of higher prices, has not been discussed here even though there is no doubt that such an effect would occur. The total costs passed along to consumers could not but reduce their well-being. Clearly, in

light of the results of the poll, Quebecers and Canadians have understood this.

There is no use in demonizing a resource if there are no realistic alternatives, or in devising projects without taking into account their costs and the population's willingness to pay them. Realistic solutions to the challenges facing humanity do exist, but they are rarely the result of a bureaucratic machine planning our collective future by determining our methods of transportation, the density of our neighbourhoods, the types of cars we drive or the kinds of jobs we hold.

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