

## PERSPECTIVE



# Electric Vehicles: Should We Believe the Rumour?

No longer a novelty or the subject of curiosity, electric vehicles (EVs) are now part of the lineup of vehicles offered by automobile manufacturers. Rumour has it that there will eventually be more EVs than internal combustion engine vehicles on the road. Until then, we may be in for a long and bumpy ride. Nevertheless, the trend appears to be here to stay. Will Quebec's economy be able to take advantage of it? With regard to raw materials, manufacturers of electric vehicle batteries are racing to secure their supplies. However, despite the recent interest of foreign companies in Quebec mining businesses. It is too soon to believe that the mining landscape will completely transform in the short term. Yet, it will be interesting to see how things develop.

### A Global Phenomenon

It would be an understatement to say that the global automobile market is undergoing major changes. Dependence on the internal combustion engine is eroding. New technologies and the desire to reduce pollution-causing emissions and improve energy efficiency are among the factors pushing automakers to offer EVs. And the changes aren't only affecting the supply side of the equation. The emergence of EVs and self-driving vehicles are forcing consumers to question their modes of transportation.

The number of EVs purchased and on the road worldwide is on the rise. However, there is some disagreement regarding the estimated current size of the market. Table 1 on page 2 provides an overview of estimates for 2016 and 2017, which vary widely for both sales and production. Some focus on sales while others focus on production. Sales stood at approximately 0.65 million to 0.75 million in 2016 and at around 1 million in 2017. Market analysts are careful to explain that the global stock of EVs comprised approximately 3 million EVs in 2017, whereas the total global stock of automobiles (EVs and conventional vehicles combined) was approximately 1 billion, which has dampened enthusiasm somewhat.

The outlook is promising for sales growth. Table 1 on page 2 shows that increases are forecast for various horizons (2020, 2025 and 2040). Of course, the speed at which sales could grow varies widely. Nevertheless, they are clearly on an upward trend. What could be driving sales? First, technological advances have reduced costs for the lithium-ion battery that currently dominates the electric vehicle market. It is estimated

that their price per kWh fell 74%<sup>1</sup> between 2010 and 2016. Over the same period, the energy density (ratio of a battery's capacity to emit a given amount of energy for a given period versus its mass) increased 5% per year. We are banking on the fact that further gains are possible. Some analysts estimate that if the current pace of technological improvements is maintained, the cost will be competitive with that of conventional engines in many countries by around 2025, or in less than 10 years.<sup>2</sup>

At the same time, if automakers began to offer more models, that would be an additional incentive for consumers. According to Bloomberg New Energy Finance (BNEF), approximately 150 models (hybrid and 100% electric) were available on the market in 2017. If we take into account forecasts by manufacturers for the coming years, that number could go as high as 240 by 2021.

### Countries that Are Leading the Pack

Who are the current market leaders? With regard to EVs on the road, China took the number-one spot in 2016 with approximately 650,000 vehicles (table 2 on page 2), according to the International Energy Agency (IEA).<sup>3</sup> That represents one third of the global stock of EVs. China also topped the list when it came to total sales for the same year (table 3 on page 2). Tables 2 and 3 on page 2 show the rapid growth from 2011 to 2016. It is also worth pointing out that Canada is not a market leader in terms of sales or vehicle stock.

<sup>1</sup> Colin McKERRACHER, [Will electric vehicles dominate the future vehicle mix?](#), Bloomberg New Energy Finance, December 6, 2017.

<sup>2</sup> *Ibid.*

<sup>3</sup> [Global EV Outlook 2017](#), International Energy Agency, June 2017, 71 p.

François Dupuis, Vice-President and Chief Economist • Joëlle Noreau, Senior Economist

Desjardins, Economic Studies: 418-835-2450 or 1 866-835-8444, ext. 5562450 • [desjardins.economics@desjardins.com](mailto:desjardins.economics@desjardins.com) • [desjardins.com/economics](http://desjardins.com/economics)

NOTE TO READERS: The letters k, M and B are used in texts and tables to refer to thousands, millions and billions respectively.

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**TABLE 1**  
**Current and future growth of the EV market around the world**

SOURCE	CURRENT MARKET	FUTURE MARKET	COMMENTS
Bloomberg New Energy Finance	2017 Sales: 1 million EVs. Stock: 3 million EVs on the road worldwide.	2040 Sales: 54% of vehicle sales will be for electric vehicles. Stock: 1/3 of the total automobile fleet.	2040 Oil: Displacement of the equivalent of 8 million barrels per day. Electricity: Consumption for EVs will reach 5% of total electricity demand.
IHS Markit	2016 Production: EVs accounted for 1% of total production of light vehicles.	2020 Production: EVs will account for 4% of total production of light vehicles.	–
European Automobile Manufacturers Association	–	2020-2025 Stock: New EVs will make up 2% to 8% of the automobile market.	–
International Energy Agency	2016 Sales: 750,000 EVs. Stock: EVs accounted for 0.2% of light passenger vehicles in circulation.	2020 Stock: Between 9 and 20 million EVs in circulation. 2025 Stock: Between 40 and 70 million EVs in circulation.	–
McKinsey	2016 Sales: 650,000 EVs.	–	–
Organization of Petroleum Exporting Countries	–	2040 Sales: Will reach 80 million EVs, or 1 out of 5 vehicles.	2040 Oil: Demand will be reduced by 2.5 million barrels per day.

EVs: Electric vehicles

Sources: Miscellaneous sites and Desjardins, Economic Studies

**TABLE 2**  
**Number of electric vehicles by country (Stock)**

	THOUSANDS		
	2011	2014	2016
Canada	0.5	10.7	29.3
China	7.0	105.4	648.8
France	3.0	31.5	84.0
Germany	1.9	24.9	72.7
India	1.3	3.4	4.8
Japan	16.1	101.7	151.3
Korea	0.3	2.8	11.2
The Netherlands	1.1	43.8	112.0
Norway	5.4	44.2	133.3
Sweden	0.2	7.3	29.3
United Kingdom	2.9	24.1	86.4
United States	21.5	290.2	563.7
Other	3.3	25.4	87.5
<b>Total</b>	<b>64.6</b>	<b>715.4</b>	<b>2,014.2</b>

Sources: Organisation for Economic Co-operation and Development and International Energy Agency

**TABLE 3**  
**Sales of electric vehicles by country**

	THOUSANDS		
	2011	2014	2016
Canada	0.5	5.1	11.6
China	5.1	73.2	336.0
France	2.7	12.6	29.5
Germany	1.7	12.7	24.6
India	0.5	0.4	0.5
Japan	12.6	32.3	24.9
Korea	0.3	1.3	5.3
The Netherlands	0.9	15.1	24.5
Norway	1.8	19.8	50.2
Sweden	0.2	4.7	13.4
United Kingdom	1.2	14.7	37.9
United States	17.7	118.8	159.6
Other	2.4	12.8	35.3
<b>Total</b>	<b>47.6</b>	<b>323.4</b>	<b>753.2</b>

Sources: Organisation for Economic Co-operation and Development and International Energy Agency

The rankings change when it comes to the share of purchased EVs versus total vehicles purchased in a given country for a given year. In this case, Norway is the clear leader. In 2016, EVs accounted for 29% of all vehicles purchased in the country that year. It was followed by Netherlands (6.4%) and Sweden (3.4%). In Norway, the government has firmly expressed its intention to eliminate the sale of conventional vehicles in 2025. According to the research firm IHS Market, legislative support and incentives have encouraged the EV buying trend in certain countries, including Norway and the Netherlands. This observation is shared by the European Automobile Manufacturers Association (ACEA), which has stated that EVs only hold a considerable market share in countries that offer significant tax and non-tax incentives. Another research firm, McKinsey, found that, in 2016, Denmark and Norway offered purchase subsidies of over 40% of the price of an EV, the highest among industrialized countries.<sup>4</sup>

The IEA also noted that global growth in EV sales has tended to slow down over time. Compared to the previous year, growth was 85% in 2014, 77% in 2015 and 60% in 2016. Nevertheless, these levels of growth remain spectacular despite the slower pace.

Many countries have clearly shown a firm intention to boost EV production and sales. China's strategy stands out as it has been launched on all fronts. By 2025, China intends to cap sales and impose quotas on conventional vehicles. Since 2016, it has seen a greater number of EVs on the road than the United States.

In addition, it aims to have world-class automakers at the ready when the EV market starts booming. In their race to achieve this goal, lithium-ion battery producers are poised to conclude agreements with large mining companies around the world. According to an analysis by McKinsey, China accounted for 43% of the world's 873,000 EVs produced in 2016. This suggests that efforts are already being felt on the prices of certain materials (lithium in particular) that are used to manufacture EVs. This issue will be addressed later in the text.

### Other Possible Scenarios

Statistics on recent sales growth could leave the impression that electric vehicles are steamrolling the market. However, the pace of their progress could slow down. Are the current infrastructures around the world able to accommodate these new vehicles (in particular, with regard to charging stations)? Are the electrical grids in emerging countries sufficient to meet demand? Are the purchase costs of EVs accessible to the middle class? Will the components necessary for the production of rechargeable batteries be available and sold at reasonable prices?

Conversely, we may see an acceleration of sales if technological developments help drive gains in battery density. In addition,

some organizations stipulate that, if governments decided to start imposing quotas on sales of internal combustion engine vehicles, it would speed up the adoption of EVs by drivers, businesses, and passenger and freight transportation companies. Others assert that the mass production of EVs would lead to economies of scale, thereby reducing the cost of acquiring an EV. Some claim that stricter energy efficiency and air quality standards would encourage automakers to pick up the pace (number of models offered and energy performance).

There are a growing number of scenarios. The IEA believes that in the next 10 to 20 years, the EV market will shift from deployment to mass adoption.<sup>5</sup> According to the BNEF, purchases of EVs will really take off in the second half of the 2020s.<sup>6</sup> In the meantime, public charging stations are on the rise. In 2016, the IEA estimated that there were 320,000 in the world, up 72% from 2015.

### Questions Are Being Raised

The emergence of EVs has been met with mixed reactions. The BNEF team estimates that between now and 2040, we should expect to see a reduction in oil consumption of up to 8 million barrels per day. The Organization of the Petroleum Exporting Countries estimates a drop of 2.5 million barrels per day, the same year. At the same time, global demand for electricity will rise by 5%. People are now wondering if electrical grids will have the capacity to meet demand. What will happen during peak periods? Will the need to build additional installations, which will likely drive up energy costs, be a deterrent for potential EV buyers? To what extent will the expected drop in production costs impact tax incentives offered by governments? Lastly, how will the loss in revenue from fuel taxes be recovered? These are just a few of the unknown variables in an increasingly complex equation that we should start to consider.

### Quebec and Electric Vehicles

As at December 31, 2017, there were approximately 21,812 EVs on Quebec's roads. They were broken down as follows: 10,054 fully electric vehicles (or 46%) and 11,758 fully rechargeable vehicles (54%) (graph 1 on page 4). According to the Association des véhicules électriques du Québec (AVÉQ), three models account for just over 60% of the market: the Chevrolet Volt (37%), the Nissan Leaf (17%) and the Tesla Model S (7%).

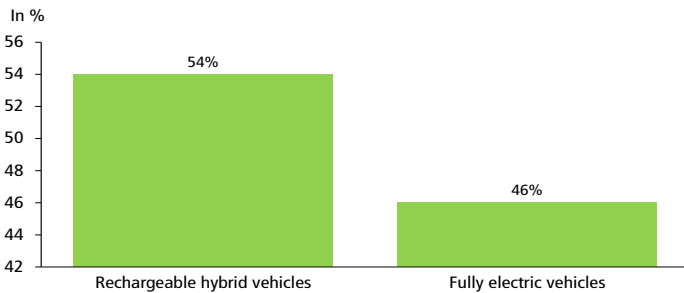
EVs can be found virtually across Quebec, as shown in graph 2 on page 4, which presents a breakdown by city. Montérégie alone accounted for just over 25% of all EVs in Quebec at the end of 2017. Lastly, a sign of the times, the number of public recharging stations exceeded 3,000 units, as shown by the figures in graph 3 on page 4. This figure is expected to rise as retailers have begun installing stations near their establishments.

<sup>4</sup> Patrick HERTZKE, Nicolai MUÉLLER and Stephanie SCHENK, *Dynamics in the global electric-vehicle market*, McKinsey, July 2017.

<sup>5</sup> *Global EV Outlook 2017*, International Energy Agency, June 2017, 71 p.

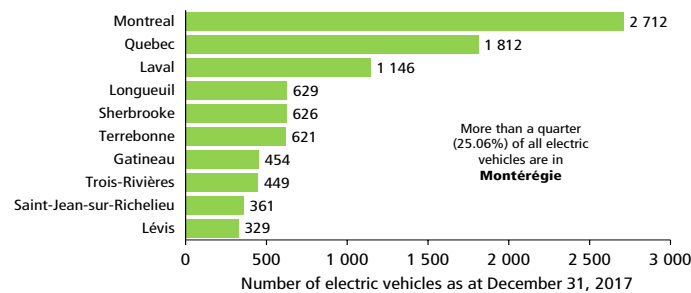
<sup>6</sup> *Electric Vehicle Outlook 2017*, Bloomberg New Finance Energy, Highlights, 2017.

**GRAPH 1**  
As at December 31, 2017, the share of fully electric vehicles in Quebec was 46%



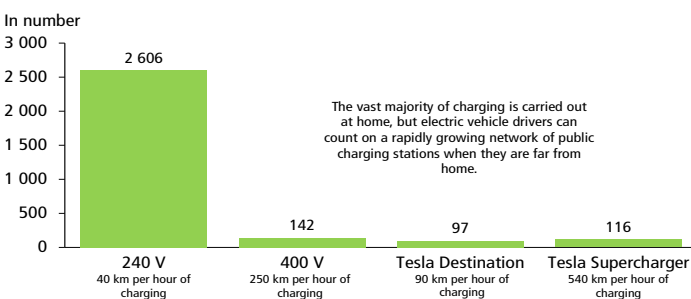
Sources: Société de l'assurance automobile du Québec, statistics on charging stations provided by ChargeHub, Canadian Plug-in Electric Vehicle Sales by Matthew Klippenstein and Desjardins, Economic Studies

**GRAPH 2**  
Quebec: Popularity extends beyond Montreal and Quebec



Sources: Société de l'assurance automobile du Québec, statistics on charging stations provided by ChargeHub, Canadian Plug-in Electric Vehicle Sales by Matthew Klippenstein and Desjardins, Economic Studies

**GRAPH 3**  
As at December 31, 2017, Quebec had more than 3,000 public charging stations



Sources: ChargeHub and Canadian Plug-in Electric Vehicle Sales by Matthew Klippenstein

In addition, Desjardins Group announced the installation of 200 charging stations across Quebec and Eastern Ontario between now and 2021.

In 2017, Quebec saw a net increase of 8,358 EVs, representing growth of 62.0% for the year. This number was slightly higher than in 2016 (60.6%). According to the AVÉQ, this corresponded to a monthly increase of just under 700 vehicles, or close

to 23 EVs per day. It should be noted that these figures are averages. The pace picked up in the second half of the year.

What could speed up this trend? The Quebec government is offering incentives to buyers. Under the Drive Electric Program, buyers can obtain a rebate of up to \$8,000 for the purchase or lease of an EV. In addition, they can receive up to \$600 for the purchase and installation of a home charging station. There is also a pilot project to promote the acquisition of used electric vehicles, under which buyers can receive up to \$4,000 for an all-electric used vehicle.

These offers come with a few privileges for EV drivers. Since the end of October 2017, EVs must have a green licence plate. This gives them free access to certain ferries, authorizes them to use reserved lanes, where permitted by signage, and provides free access to Autoroutes 25 and 30 via a transponder obtained from toll authorities as part of a pilot project,<sup>7</sup> in addition to free parking in certain municipalities. These are just a few of the privileges associated with a green licence plate.

In addition to incentives and privileges, other actions have been taken to accelerate the shift to electric vehicles. The National Assembly of Québec unanimously adopted the zero-emission vehicle (ZEV) standard. The standard took effect on January 11, 2018 and concerns automakers. The ZEV standard is aimed at encouraging the automobile market to develop more models that use carbon emission-reducing technology and are increasingly energy efficient. Where does Quebec stand with regard to the major automakers? It may seem insignificant, but Quebec has joined 10 U.S. states, including California, in adopting similar proposals. It should also be pointed out that the Quebec government's Transportation Electrification Action Plan 2015-2020 aims to see 100,000 plug-in vehicles on its roads by 2020.

In addition, automakers have announced the arrival of a wider range of EV models for 2018. A wider range of choices may attract more buyers. As a sign of Quebec's growing enthusiasm, Montreal just hosted the second annual Electric Vehicle Show this spring.

Lastly, we cannot neglect to mention the recent creation of a centre of excellence for transportation electrification and energy banking last March. This body is tasked with marketing Hydro-Québec's technology, which is protected by 800 patents. The expertise they have developed over the last 40 years includes lithium-ion, lithium-sulfur and lithium-air batteries. Quebec is ahead of the rest of Canada in many ways.

<sup>7</sup> Privileges associated with a green licence plate, Société de l'assurance automobile.

### Speeding Up Progress

Some would like to see Quebec adopt EVs more quickly. This is particularly true for the Institut de recherche en économie contemporaine (IRÉC), which published a technical brief in April 2018.<sup>8</sup> It would like Quebec to commit to banning internal combustion engine vehicles in the near or medium term, following in the footsteps of Norway (horizon: 2025), France (2040) and Germany (2040), in particular. The institute believes that by 2022, the sale price of EVs will have dropped to that of conventional vehicles. At that point, electricity consumption for EVs will rise exponentially. According to IRÉC's calculations, replacing gas-powered vehicles with electric vehicles would represent a net gain in purchasing power of \$2 billion between now and 2030.

While it is estimated that Hydro-Québec will see additional income of \$1.5 billion, the issue of the losses in taxes currently collected by governments associated with the drop in gasoline sales has not yet been resolved. Can the governments do without this revenue? In the last budget, the Quebec government estimated its own-source revenue from the specific tax on fuel at \$2.3 billion for 2017–2018.<sup>9</sup> This figure takes into account kerosene fuel (domestic), aviation fuel and fuel oil for locomotives.

### Impact on Quebec

In addition to increased electricity consumption in Quebec, can we expect other consequences? We previously mentioned increased demand for raw materials such as lithium, cobalt, rare earth elements, graphite, nickel, copper and several other materials. Some research firms believe we do not need to fear a shortage of these due to technological developments, which will enable the production of batteries using other raw materials at a lower cost.

Other institutions assert that sales forecasts for EVs are greatly exaggerated and that there is even a risk of overproduction of materials, particularly lithium, which would cause a significant drop in prices. This belief is not universally held, as shown by certain indexes. In the case of lithium, prices have risen significantly in recent years.

In addition, we are seeing a growing number of electric vehicle manufacturers attempting to secure their supplies by purchasing stakes in mining projects. For example, at the beginning of the year, Great Wall, a Chinese automaker, bought stakes in Pilbara Minerals in Australia. Toyota Tsusho, a company belonging to the Toyota Group, acquired a 15% stake in Orocobre Limited, a mining company with interests in lithium, in Argentina (the world's third-largest producer in 2017, with a 12.8% share).

We are seeing this trend play out in Quebec as well. Although Canada (Quebec in particular) is not known as a major producer of lithium at this moment (it doesn't appear on lists of major global producers as it produces less than 0.5% of global supply), graphite (estimated at 2.5% in 2017) or cobalt (estimated at 3.9%), it has begun to pique some interest. For example, in early 2018, Contemporary Amperex Technology, a major Chinese lithium-ion battery manufacturer, acquired a 90% share of North American Lithium, which operates a mine in La Corne, Abitibi-Témiscamingue.

In April of this year, Nemaska Lithium, which has a mine in Wabouchi and a processing plant in Shawinigan, sold 9.9% of its shares to a Japanese company, SoftBank. This Japanese consortium, which includes Internet access providers and is a mobile and fixed telephone operator, paid CAN\$99 million, which will help finance operations of the mine and plant in Quebec. However, when it comes to global production, Quebec is far from being a major player at this moment. According to the U.S. Geological Survey,<sup>10</sup> global lithium production in 2017 was dominated by Australia and Chile, which accounted for 43% and 33%, respectively.

Lastly, these minerals (lithium, graphite and cobalt) do not represent the bulk of exploration and production in Quebec in the last years. Precious metals, particularly gold, play a far greater role.

### Are There any Downsides?

While the emergence of electric vehicles has been heralded by numerous governments and consumers, not everyone shares their enthusiasm. For some, it is more important to "stabilize" the automobile stock than to introduce new, cleaner vehicles. Others say that the additional production of electricity is not carbon-neutral, and that it comes with an environmental cost. Furthermore, the race to secure rare metal elements is having social impacts as well as repercussions on natural areas. Selling cars at their actual cost (physical, environmental and social) would already be a step in the right direction.

Others believe that new technologies require more resources than old technologies to produce the same amount of energy. They also highlight the following paradox: we are using non-renewable resources to produce renewal forms of energy. Very few rare earth elements (lithium in particular) are currently recycled. The race for new materials to power lithium-ion batteries requires an increasing amount of energy to extract them and forces miners to work in abject conditions, particularly in emerging countries.

<sup>8</sup> Gilles L. BOURQUE, *Bannir les véhicules à combustion : pourquoi pas au Québec?*, IRÉC, April 2018, 2 p.

<sup>9</sup> *The Quebec Economic Plan*, Gouvernement du Québec, Finances Québec, Budget 2018-2019, March 2018, p. F55.

<sup>10</sup> *Mineral Commodity Summaries 2018*, United States Department of the Interior, United States Geological Survey, January 2018, 204 p.

### **Too Soon to Talk About a Major Transformation**

EVs are increasingly seen on the roads of Quebec and around the world. Although their share of the global automobile stock is still marginal, it is growing. However, we still have a ways to go, both from a technological perspective and in terms of supplying potential buyers. For some sceptics, these new vehicles have yet to prove their environmental worth. Quebec is currently ahead of the rest of Canada, particularly in the number of EVs on the road in the province and initiatives aimed at facilitating their introduction. There is no secret to electricity production: the energy is there; we just need to make it available to drivers. However, in the race to secure raw materials supplies, the province is far from leading the pack, despite the recent interest shown by foreign companies. It is too soon to believe that the mining landscape will completely transform in the short term. Yet, it will be interesting to see how things develop.

**Joëlle Noreau**, Senior Economist