

HARNESSING MANITOBA'S ELECTRICITY

REDUCING THE OVERALL COST OF ENERGY TO MANITOBANS

Manitoba Energy Council

<https://manitobaenergycouncil.ca/>

by

Garland Laliberte, P.Eng.

Dennis Woodford, P.Eng.

February, 2019



Contact Information:

Dr. Garland Laliberte, P.Eng.

garlalib@gmail.com

Dennis Woodford, P.Eng.

daw@electranix.com

Preamble: Manitoba--the Land of Opportunity

In his annual address to the Winnipeg Chamber of Commerce on December 6, Premier Brian Pallister released his Government's blueprint for Manitoba's economic future. That future, he announced, is set out in *Growing Manitoba's Economy* submitted recently to the Government of Manitoba by Barb Gamey and Dave Angus who led a six-month consultation to garner the views of 500 individuals and organizations on Manitoba's economic opportunities. The 16-page report lays out guidelines in broad general terms that would allow Manitoba to capitalize on our economic strengths and meet our challenges head on.

Premier Pallister said that the Government's role in this effort will be led by the Economic Development Committee of Cabinet which is chaired by Blaine Pedersen, Minister of Growth, Enterprise and Trade. The Premier also announced that his Government would be establishing an Economic Development Office with a goal of transforming the delivery of programs to be achieved in partnership with regional and sector-specific bodies.

From the point of view of the Manitoba Energy Council, the timing was fortuitous. The Council was established only a month earlier and had been contemplating ways in which it could connect with the Government and other stakeholders in putting Manitoba's abundant hydro-energy to work for the socio-economic benefit of Manitobans.

Manitoba Hydro has built a reliable system for the supply of electricity for residents and businesses in Manitoba. But the system is capable of producing more electricity than Manitobans currently need. Today the surplus is sold primarily into the US market. A recent announcement of a planned sale to Saskatchewan beginning in 2022 is a welcome development because it expands and diversifies the extra-provincial market. Manitoba's electricity is a clean source of energy and that is a selling feature in the external market, especially as those markets respond to demands for a reduced carbon footprint.

However, Manitoba's hydro-electricity should benefit Manitobans too as we accept our share of the responsibility for reducing carbon emissions. It also opens up opportunities to develop or expand industries that can use our clean electricity.

Harnessing Manitoba's Electricity
Reducing the Overall Cost of Energy to Manitobans

We are a manufacturing centre for electric buses sold internationally. We have a major university with faculties of engineering, science and agriculture and a community college with an established record in producing sought-after technology graduates. Manitoba has been a centre of expertise for the development of lightweight and strong aerospace materials. We have under-developed deposits of lithium and a mining industry that is looking for new markets for its nickel.

What is stopping us from not only extracting the raw materials from the rich minerals deposits in our province but in refining them for export and for use in the manufacture of electric vehicles (EVs)? Why not, in fact, exploit our knowledge of aerospace materials for the full-fledged manufacture of EVs? We have already demonstrated our capacity for harnessing our natural and human resources for the manufacture of agricultural equipment and energy-efficient electric buses and for repair and maintenance in the aviation industry.

The Government's initiative is timely in that it opens up the opportunity to begin the dialog that can harness our resources for the benefit of all Manitobans.

Efficiency Manitoba

The annual savings targets for electricity for which Efficiency Manitoba has been given responsibility in the 15-year period following the commencement date of The Efficiency Manitoba Act¹ are set out in Section 7(1) of the Act as follows:

In the initial year following the commencement date, net savings that are at least equal to 1.5% of the consumption of electrical energy in the preceding year.

In each of the following years, incremental net savings that are at least equal to 1.5% of the consumption of electrical energy in the immediately preceding year.

¹ <https://web2.gov.mb.ca/laws/statutes/2017/pdf/c01817.pdf>

Manitoba Energy Council

Harnessing Manitoba's Electricity
Reducing the Overall Cost of Energy to Manitobans

In other words, the Act requires annual savings targets of 1.5% of electrical consumption from the previous year for each of the next 15 years.

In the Position Profile for the Chief Executive Officer of Efficiency Manitoba², the organization is described as:

Efficiency Manitoba will help Manitobans reduce their utility bills, save energy and reduce greenhouse gases. Staff will work closely with the public, the private sector, non-government organizations, Indigenous parties, Manitoba Hydro and Centra Gas, and others to implement effective energy efficiency program.

The vision¹ is to make Manitoba *Canada's cleanest, greenest and most climate resilient province.*

The mandate for the CEO of Efficiency Manitoba and the vision for Manitoba are in harmony with the objectives of the Manitoba Energy Council which is an organization dedicated to providing independent, apolitical, volunteer and professional advice and feedback for the sustained development of energy in Manitoba.

Having already contributed significantly in past careers to energy development and use in the province, the Council's members are able to provide independent, apolitical, volunteer and professional advice and feedback to Efficiency Manitoba, Manitoba Hydro and other bodies responsible for the sustained development of energy in Manitoba. The Council's contributions are intended for the ultimate benefit of every Manitoban.

The Game Changer in Energy

There is little disagreement that change is coming to disrupt the supply and use of energy except whether it is already occurring or soon will. When the change arrives,

² Position Profile for the Chief Executive Officer of Efficiency Manitoba, June 2018

Harnessing Manitoba's Electricity
Reducing the Overall Cost of Energy to Manitobans

it will *likely cause major havoc on incumbents who are unprepared for the change and/or still in denial.*³

What are the early signs of this disruption to the supply and use of energy?

- Wind and solar generation are the cheapest means to generate electricity at much less cost than new hydroelectricity (e.g. Site C in BC, Keeyask and Wuskwatim in Manitoba and Muskrat Falls in Labrador).
- Electric vehicles (EVs) are about to reach cost parity with cars/trucks using internal combustion engines (ICEs).
- Energy storage is poised to become big business.
- Peak oil in Canada was reached in 2017.⁴
- The decline in coal is continuing into the foreseeable future.⁴

In Manitoba, we have an oversupply of hydroelectricity and the cost of surplus energy generated from Wuskwatim and Keeyask far exceeds the export price received as this energy is exported. Export prices for our electricity will continue to be held down by the low cost of electricity generated by wind, solar and gas in the US and Saskatchewan. Right now, Manitoba Hydro has to compete against low prices in the external market and rely of price increases in domestic energy to make up the difference.

Disruption to Energy in the Past and the Present

In 1900, the main mode of domestic transportation was the horse-drawn vehicle. At that time, the manufacture of carriages, harness and saddles was big business.

³ EEnergy Informer, The International Energy Newsletter, January 2019

⁴ National Energy Board, Canada's Energy Future 2018: Supply and Demand Projection to 2040 (EF2918), <https://www.neb-one.gc.ca/nrg/ntgrtd/ft/2018/xctvsmmr-eng.html>

Harnessing Manitoba's Electricity
Reducing the Overall Cost of Energy to Manitobans



Figure 1: Example of carriage and harness advertising (rights obtained)

The disruptive change in transportation from 1900 to 1913 is evident in Figure 2.



(a) New York 1900



(b) New York 1913

Figure 2. The disruption from horse-drawn carriages to motor vehicles (George Grantham Bain collection, Library of Congress)

The distress of this transportation disruption caused a significant change of employment opportunities from carriage, harness and saddle manufacturing to automobile manufacturing.

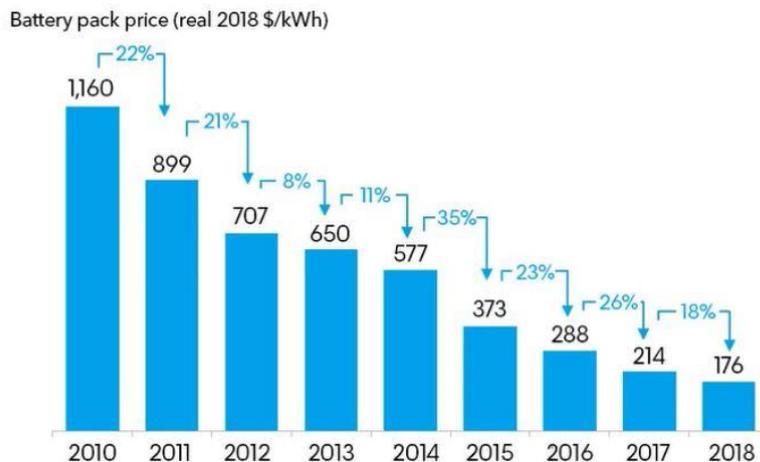
Can Manitoba ignore the change from gasoline and diesel-driven vehicles to electric vehicles? All predictions are that the purchase of electric vehicles (EVs) will happen

Harnessing Manitoba's Electricity
Reducing the Overall Cost of Energy to Manitobans

at an exponential rate while regular automobile sales are slowing down and even flattening out.

Here are the predictions by 2018 Bloomberg New Energy Finance⁵:

- *By 2040, 55% of all new car sales and 33% of the global fleet will be electric.*
- *China is and will continue to be the largest EV market in the world through 2040.*
- *EV costs. The upfront cost of EVs will become competitive on an unsubsidized basis starting in 2024. By 2029, almost all segments reach parity as battery prices continue to fall.*



GIF: BloombergNEF. Note: The data in this chart has been adjusted to be in real 2018 dollars.

Figure 3: The falling prices of batteries

- *E-buses. Buses go electric faster than light duty vehicles.*

Recently, Warren Buffett-backed Chinese EV car maker BYD announced that it has shipped 100 electric buses to Santiago⁶, the capital city of Chile, with another

⁵ <https://about.bnef.com/electric-vehicle-outlook/#toc-download>

⁶ <https://www.reuters.com/article/chile-environment-electricvehicles/enel-byd-say-chile-electric-bus-roll-out-heralds-more-for-region-idUSL1N1YI1HB?feedType=RSS&feedName=companyNews>

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans

100 to follow. BYD is working in collaboration with ENEL, one of Europe's largest electric utilities for e-bus sales in South America. Can this be a model for New Flyer and Manitoba Hydro in North America?⁷ (Emphasis added).



Figure 4: BYD buses in Santiago, Chile⁸

- **Displacement of transport fuel.** Electrified buses and cars will displace a combined 7.3 million barrels per day of transportation fuel in 2040.

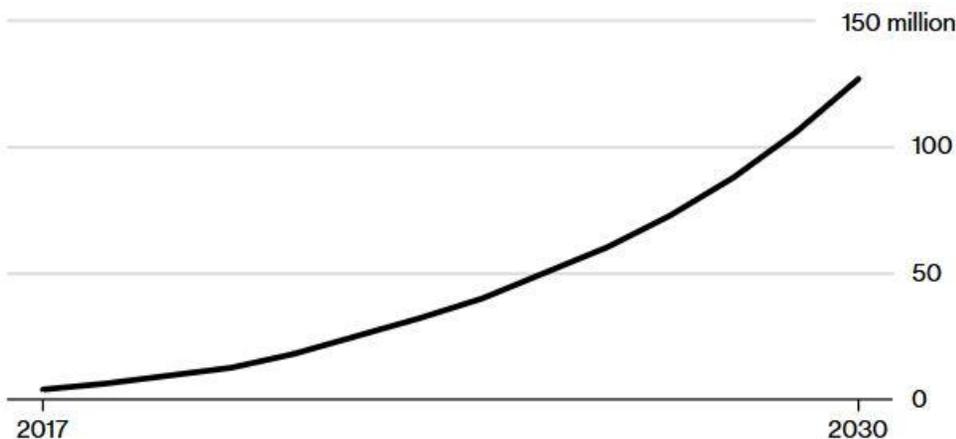


Figure 5: The global fleet of EVs is set to soar. (Source: International Energy Agency)

⁷ The archaic Manitoba Hydro Act will need revision to productively accommodate e-mobility and the changing grid

⁸ <https://techcrunch.com/2018/12/14/byd-electric-buses-chile/>

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans

The move to electric mobility of cars, buses and trucks in Manitoba is inevitable. The province cannot remain in denial of this trend. The provincial government recognizes the advantages in using electric buses and including EVs in government operations⁹. But the plan must expand to make a significant reduction in the overall cost of Energy to Manitobans.

The electrification trend of buses is spreading fast. The City of Winnipeg is asking for an electric bus study with an eye to the future¹⁰. New York City, home to America's largest bus network, says its 5,700 buses will be all-electric by 2040. Los Angeles, the second-largest bus fleet, will convert all 2,300 buses to electric by 2030. San Francisco, home to 1,100 municipal buses, just announced it will be all-electric by 2035 and will purchase exclusively electric buses by 2025¹¹.

Reducing Energy Costs to Manitobans

The Efficiency Manitoba Act, as it is now written, requires that *Efficiency Manitoba will help Manitobans reduce their utility bills and save energy.*

To reduce overall energy costs to Manitobans, all energy must be included.

Reduction of imported refined gasoline and diesel will follow as Manitobans turn to the inevitable lower-priced electric vehicles. Productive use of Manitoba's surplus electricity for EVs provides a much cheaper automotive fuel than gasoline or diesel.

By way of a real example to illustrate how the total energy costs to Manitobans will reduce with an electric vehicle, consider this example:

⁹ A Made-in-Manitoba Climate and Green Plan, Hearing from Manitobans, Manitoba Sustainable Development, https://www.gov.mb.ca/asset_library/en/climatechange/climategreenplandiscussionpaper.pdf

¹⁰ <https://www.winnipegfreepress.com/local/city-asks-for-electric-bus-study-with-eye-to-future-503819112.html>

¹¹ <https://www.forbes.com/sites/energyinnovation/2018/05/21/electric-buses-can-save-americas-local-governments-billions-chinas-showing-us-how-its-done/#1800ce9a5f78>

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans

- A Manitoban has owned a Nissan Leaf electric vehicle for 31 months, and travelled 34,000 km. The average of summer and winter distance the electric vehicle travels is 36 km/day at about 8.6 kWh/day. At a Manitoba Hydro residential rate of 8.7 cents/kWh, the electric fuel cost charging at home amounts to \$0.79/day.
- A comparative internal combustion car is a Nissan Sentra operating in city driving is 8.1 litres/100 km¹². For 36 km/day, the daily fuel cost at about \$1.0/litre is \$2.92/day – 3.7 times the fuel cost of the Nissan Leaf.
- There is a 14 cents/litre provincial road tax which, for the Nissan Sentra gasoline-fueled car, amounts to \$149/year. The expeditious way to apply a road tax to an electric vehicle is a generous fixed price per car of say \$200/year (administered through annual car registration).
- If, in the interest of fairness, an energy tax is considered to have been applied to EVs, the total energy and tax cost of the EV would be about \$288/year (for electric energy) + \$200/year (for provincial tax) = \$488/year for the Nissan Leaf and \$1,066/year for the Nissan Sentra.
- In the 31 months, the Nissan Leaf maintenance costs have been a minimal at about \$50/year while a Nissan Sentra annual maintenance costs could be at least \$300/year.
- In this example, the total operating costs (energy and maintenance) of the EV saves its owner \$828/year compared to a comparative gasoline-fueled car.
- Annual energy costs (excluding gas home heating) for a residential owner using 1000 kwh/month at 8.7 cents/kWh, amounts to \$87/month and \$1,044/year. With the electric car this would increase to \$1,044 + \$488 = \$1,532/year.

¹² <https://www.nissan.ca/en/cars/sentra/versions-specs.html>

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans

- That same residential owner with the comparable gasoline-fueled car is spending annually on energy (excluding gas home heating) $\$1,044 + \$1,066 = \$2,110/\text{year}$.

Comparisons are shown in Figure 6 including estimates for maintenance.

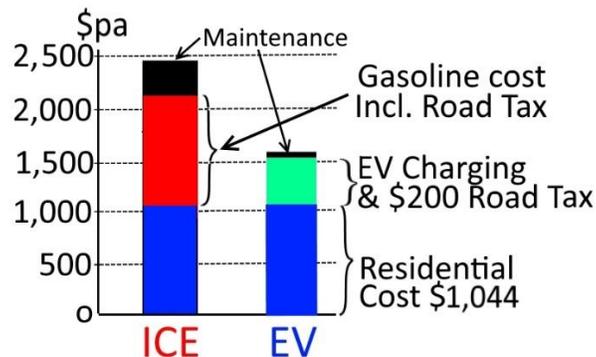


Figure 6: Comparative annual energy costs plus maintenance between a car with an internal combustion engine (ICE) and an electric vehicle (EV)

The residential cost of electricity can be reduced by an effective energy efficiency program by Efficiency Manitoba. Efficiency Manitoba can help Manitobans to further reduce their total energy costs by getting behind programs that accelerate the adoption of EVs.

Additional Benefits of Electric Transportation

As the purchase cost of EVs falls to the level where they are more economical to purchase than cars fueled by gasoline or diesel, there are additional advantages that will benefit Manitobans and their provincial government. These are:

- Less refined gasoline and diesel will be imported into Manitoba resulting more dollars retained within the province contributing to a stronger economy.

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans

- There will be a reduction of harmful exhaust emissions detrimental to human health.¹³
- There will be an increasing incentive to develop sustainable lithium mining in eastern and northern Manitoba. See Figure 7:
- With our own lithium mining, there will be an advantage to open up one or more lithium ion battery manufacturing plants near the mines – to use mined lithium as an instrument of provincial economic development instead of just exporting it as a raw material.
- As school and transit diesel buses retire, they must be replaced with electric buses. The development of hydrogen is evolving too as a fuel that may be generated from electricity for fuel cell-based cars, buses and transport trucks.¹⁴
- With the inevitable increased sale of EVs and buses within the province, greater demand for Manitoba Hydro's hydroelectricity will occur in the province. The increasing revenue for electric energy sold by Manitoba Hydro for EVs and electric buses in the province will generate a higher price than exporting its excess energy at very low and unprofitable rates. This will result in less debt to be shouldered by our children and grandchildren and help lower electricity rate increases. It will reduce the temptation to engage in accounting practices that merely kick the can down the road.

¹³ There are many references about the adverse impact of car and truck exhaust emissions on human health. For example, the Union of Concerned Scientists states: “Cars, trucks, and buses powered by fossil fuels are major contributors to air pollution—transportation emits more than half of nitrogen oxides in our air, and is a major source of global warming emissions in the US. Studies have linked pollutants from vehicle exhaust to adverse impacts on nearly every organ system in the body.” <https://www.ucsusa.org/clean-vehicles/vehicles-air-pollution-and-human-health/cars-trucks-air-pollution#.XCd8Rc171PY>

Health Canada completed the *Human Health Risk Assessment for Diesel Exhaust*. “Overall, it is concluded that diesel emission is associated with significant population health impacts in Canada and efforts should continue to further reduce emissions of and human exposures to diesel emission”

¹⁴ Example, Nikola Motors: <https://nikolamotor.com/motor>

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans

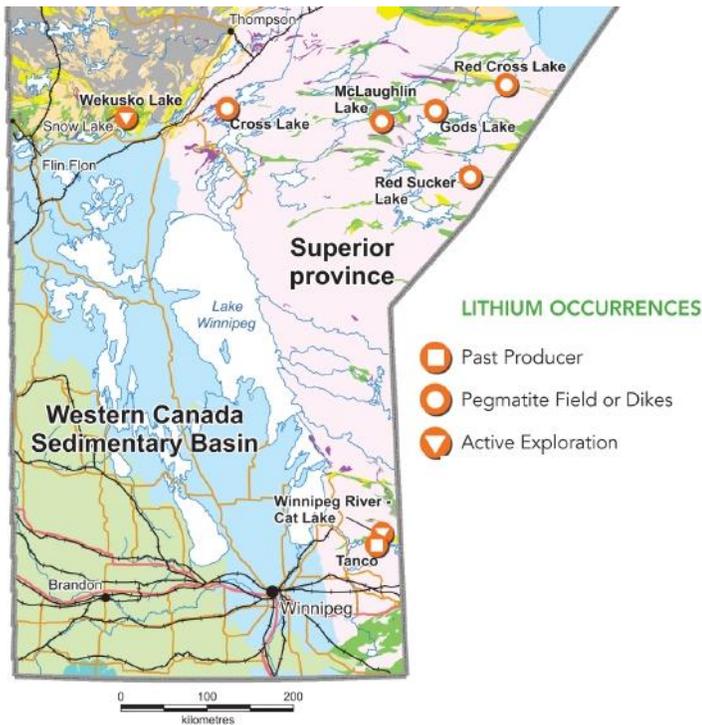


Figure 7: Manitoba geological map showing location of lithium-bearing fields (Source: Manitoba Government brochure: INVEST. BUILD. GROW)

- New business opportunities will arise including sourcing charging stations and developing home-charging capabilities. In many instances, overnight charging at home from a 110-volt outlet will be adequate. If faster home charging is needed, it may be necessary to install 220-volt outlets just as is done for electric washing machines and driers. It may also be necessary to add smart-phone activated charging capability in parking garages, and along streets where needed as shown in Figure 8 for streets in Paris where there is a lack of garage space in apartments.

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans



Figure 8: EV charging stations on the streets of Paris

It may be necessary to revise The Manitoba Hydro Act to enable Manitoba Hydro to support the strategic installation of electric chargers as needed in the cities, towns and countryside of Manitoba similar to what Electricité de France (EDF) is doing in Europe.¹⁵

In Manitoba, EV charging stations have been established in the parking lots of businesses such as IKEA in Winnipeg and the Edmond Financial Group on Academy Road in Winnipeg as shown in Figure 9. Convenience stores, fast food outlets and gas stations on highways are obvious places for EV charging. So too are shopping centre parking lots.

¹⁵ French energy giant EDF intends to operate 75,000 charging stations in Europe by 2022 as it aims for a 30% market share in its main markets of France, Belgium, Italy and the UK. “We want to become the uncontested leader in electric mobility in Europe by 2022”, declares CEO Jean-Bernard Levy. <https://www.electrive.com/2018/10/11/french-edf-to-install-75000-charging-stations-until-2022/>

Harnessing Manitoba's Electricity
Reducing the Overall Cost of Energy to Manitobans



Figure 9: Charging stations at Edmond Financial Group for client and employees during business hours and open to the public after 6:00 pm

Disruptions from Electric Vehicles

The energy disruptions coming will include employment transition and loss. As the replacement of horse and carriages with automobiles occurred after the change into the 20th century resulting in change, so too will the arrival of the electric car.

Issues of concern include:

- Less consumption of oil. Although peak oil has been reached in Canada in 2017⁴, oil will still be around for a long time. Gas stations will still be required

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans

for decades to come but Canada's domestic oil industry's best years may have passed.

- Electric cars require much less maintenance than a car with an internal combustion engine. This means fewer automotive maintenance personnel.
- Manufacturing of an EV is mechanically simpler than manufacturing a car with an internal combustion engine and so there is a reduced supply chain. Thus, fewer EV automotive manufacturing employees per car from the supply chain. Possibly a simpler assembly line will be the likely outcome. Is there any reason why an EV car could not be assembled in Manitoba to help with employment and boost the economy?

Increased loading to the grid with EVs may not materialize because of the gains in energy efficiency that have already been achieved by Manitoba Hydro and will be possible with Efficiency Manitoba. It was anticipated that, in 2016, the Power Smart program then run by Manitoba Hydro could lower load so much it would counteract the need for Keeyask.¹⁶ We will have Bipole III (\$B5), Keeyask (\$B8.7) and the Manitoba/Minnesota Transmission Project (\$B1.1) with a purpose to send electricity for export. This means that every kilowatt hour saved by Efficiency Manitoba will be exported at a lower price. This is a decided disadvantage since our electricity rates must increase to keep the accumulating debt manageable. The average historical value of our exported electricity is shown in Figure 10.

With years that have lower water in the dams and rivers, then the contract exports must be honored first. Less energy is sold and exported into the lower-valued spot or opportunity markets. This causes the average export price to rise as seen in 2018 where it is about \$41/MWh (or 4.1 cents/kWh) but the overall export revenue received will be less than when the water levels are higher for the year. If the Canadian dollar stays low compared with the US dollar, this too will have a positive impact on export revenues.

¹⁶ Manitoba Hydro's "2013-2016 Power Smart Plan – An overview of Manitoba Hydro's energy efficiency initiatives for the next three years." Wherein it states on page 1 over the three years of the plan that: "*These energy savings are equivalent to approximately 80% of the firm generation capability of Keeyask Generation Station or 1/3rd of the electrical energy needs of Winnipeg (excluding industrial customers).*" http://www.pub.gov.mb.ca/nfat/pdf/hydro_application/appendix_e_2013_16_power_smart_plan.pdf

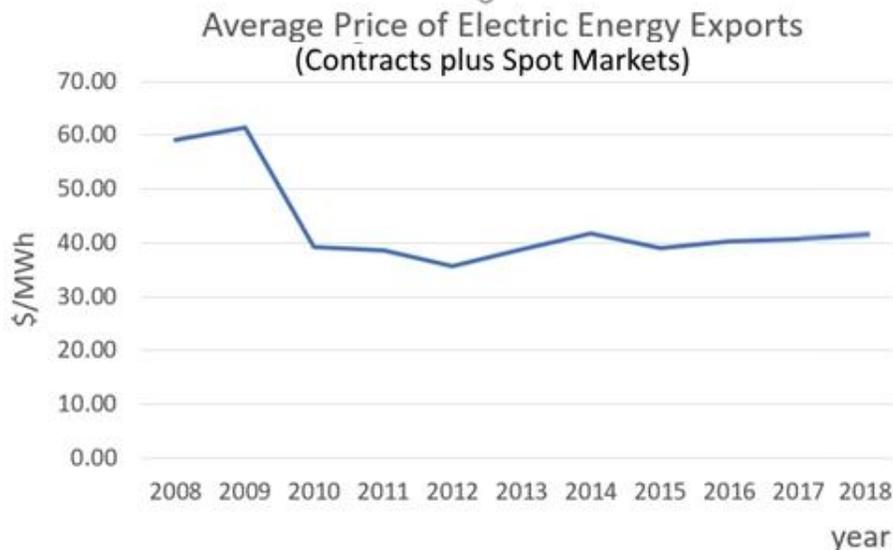


Figure 10: Manitoba Hydro average export market prices in Canadian dollars
(Source: Manitoba Hydro Annual Reports from fiscal years ending 2008 to 2018)

The average price of electric energy export markets cannot be expected to rise above the \$60/MWh of 2008 and 2009 again because Manitoba Hydro has to compete on the export market with low-cost natural gas generated electricity (around 6 cents/kWh) and the falling costs of solar and wind renewable generators less than 6 cents/kWh.

The energy that Keeyask can generate each year on average is stated by Manitoba Hydro¹⁷ to be 4,400 GWh which, once completed in 2021, will be exported at around 4 cents/kWh (Figure 10). If all of its costs are considered, energy from Keeyask will cost much more than that, over 12 cents/kWh by the time it reaches a Manitoba border. This will be exacerbated by an aggressive Efficiency Manitoba program. Keeyask will generate enough energy for about one million electric vehicles or more.¹⁸ By 2021, if electricity rate increases are held down each year to 3.6% by the

¹⁷ <https://www.hydro.mb.ca/projects/keeyask/>

¹⁸ The number of vehicles weighing less than 4,500 kilograms in Manitoba in 2017 was 794,440 and 4348 busses. <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2310006701&pickMembers%5B0%5D=1.8>

Public Utilities Board, the residential electricity rate in Manitoba will be around 9.7 cents/kWh before taxes, more if the basic charge is considered.

The bright side of Manitoba Hydro's worrisome need for ongoing rate increases is that every kWh of energy that charging an electric vehicle will take away from export is a kWh in 2021 for which Manitoba Hydro will receive revenue of at least 9.7 cents/kWh rather than around 4 cents/kWh if exported. This will help Manitoba Hydro's financial condition and ease the rate increase requirements to ratepayers.

Moving Forward Serving Manitobans with the Lowest Cost Energy

The Manitoba Energy Council considers that there are many stakeholders who will benefit from a coordinated, innovative and thoughtful approach to energy production, conservation and use in the province. Among them are the Province of Manitoba, Manitoba Hydro, Efficiency Manitoba, municipal governments, Manitoba industry and commercial enterprise. But most of all, it will be the people of Manitoba, including our children. The Manitoba Energy Council urges:

- the City of Winnipeg to give a high priority to a plan which will gradually replace its diesel-burning buses with electric buses
- the Government of Manitoba to promote the development in other Manitoba cities of plans to replace diesel-burning buses with electric buses
- in recognition of the health benefits of reducing the impact of diesel fumes on the health of school children and staff, the Province of Manitoba to promote the development in the province's school districts of plans to replace diesel-burning buses with electric buses and to help with the resources necessary to implement those plans
- under the aegis of the Cabinet Economic Development Committee and with the help of the Economic Development Office, the Minister of Growth, Enterprise and Trade to enlist the support of the Minister of

Harnessing Manitoba's Electricity Reducing the Overall Cost of Energy to Manitobans

Crown Services, the Minister of Sustainable Development, the Minister of Infrastructure, the Minister of Education and Training, the Minister of Municipal Relations, the Minister of Indigenous and Northern Relations and Grand Chief Arlen Dumas of the Assembly of Manitoba Chiefs in order to;

- develop a plan under the aegis of Efficiency Manitoba and with the cooperation of the Minister of Crown Services that saves electrical energy while keeping the cost for Manitobans as low as possible
- develop a network of charging stations for EVs in Manitoba
- ensure that Red River Community College, the Assiniboine Community College, the University College of the North (if appropriate) and the technical high schools in the province have programs in place to train electricians and others to install EV chargers and to meet the associated technical requirements of an EV charging network
- develop and support the sustainable exploration for and the mining of minerals for batteries in a way that protects the province's water, its land, its air and its people
- investigate and promote investor interest in the manufacture of lithium ion batteries or their successor, possibly in close vicinity to a promising lithium mine in Manitoba (as, for example, Tesla has done at a lithium mine in Nevada)
- investigate interest by global EV manufacturers in assembling EVs in Manitoba while sourcing inputs as much as possible from the Manitoba supply chain