**Disruptive Influences Call for a Nimble Approach to Planning**
**a 1 February 2018 presentation to the Manitoba Public Utilities Board**
**delivered by Dennis Woodford, P.Eng. on behalf of the Bipole III Coalition**
**in the matter of Manitoba Hydro's 2017-18 and 2018-19 General Rate Application**

## The Need for Manitoba Hydro to be Nimble:

Manitoba Hydro and its governments have been caught flatfooted as their process of planning lumbers along as it has done for many decades, apparently oblivious to the disruptive changes that have been occurring now for a decade.

The whole planning environment of Manitoba Hydro and the process by which it has been directed has to change. It has to be nimble and more responsive to the energy disruptions that are happening right under their noses, otherwise we the rate-payers suffer severe consequences.

Manitoba Hydro's Preferred Development Plan was predicated on exports[1]. Predicting the future is far from certain and we create the future. So, starting from the PUB NFAT Review of Manitoba Hydro released in June 2014, we can see in hindsight how far off the predictions made only four years ago were and what has been created since then as we see the unfortunate results today in 2018.

What has encumbered the actions by Manitoba Hydro since June 2014, is their lack of nimble and flexible action as unexpected external conditions were imposed upon them. This presentation to the PUB for the 2017-18 and 2019-19 General Rate Application focusses on the need for a modern electric power utility to be nimble and to react quickly to the rapidly changing energy system that is upon us.

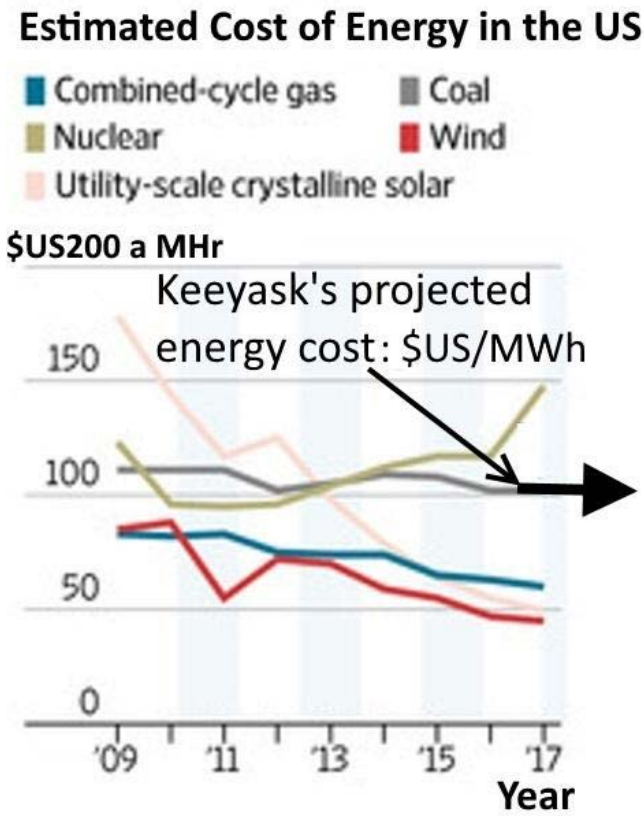
## The Reducing Demand for Electricity from Utilities:

Wholesale electricity prices were falling in the US for most fuel sources as shown in Figure 1. In the NFAT review of 2014, when the PUB gave approval to proceed with Keeyask, its capital cost was presented as $6.5 billion[2]. In addition, Manitoba Hydro assumed long-term interest rates rising to 6.75% from 2019 onwards[3]. Using these 2014 values, adding in 2% for depreciation, and ignoring water rentals, operations and maintenance, the annual cost of the 4,430 GWh of annual energy at the terminals of the Keeyask hydroelectric generating station by simplified calculation is $128/MWh. This price is added to Figure 1 and transferred to US dollars at $US101 MWh.

[1] PUB NFAT Review of Manitoba Hydro's Preferred Development Plan, June 2014, p 30 of 306

[2] PUB NFAT Review of Manitoba Hydro's Preferred Development Plan, June 2014, p 47 of 306

[3] PUB NFAT Review of Manitoba Hydro's Preferred Development Plan, June 2014,p 200 of 306




Source: The Wall Street Journal, Nov 30, 2017

Figure 1: An historical review of estimated costs of generated energy in the US from 2009 to 2017 with the projected cost of Keeyask energy as of 2014 superimposed

Manitoba Hydro's analyses today do not allow for isolating the economics of Keeyask. Nevertheless, it needs to be done to allow the project to be re-evaluated as it should be. Of course, the cost of energy generated by Keeyask today with its capital cost approaching $10 Billion, and interest rates on the rise will be much higher in Canadian dollars than the $128/MWh presented above.

It was evident in 2014 that load growth for electric utilities was falling away, in part because of aggressive DSM, and because of growth of home generation from solar panels and investor-owned wind farms. Manitoba, from the border with the US to Churchill generally has more hours of sunlight per year than anywhere in Northern Europe where solar generation is abundant, particularly in Germany. This is summarized in Table 1. Consider also that solar panels are more efficient in the cold:

Table 1: Hours of Sunshine/Year in Manitoba and in Northern European Cities

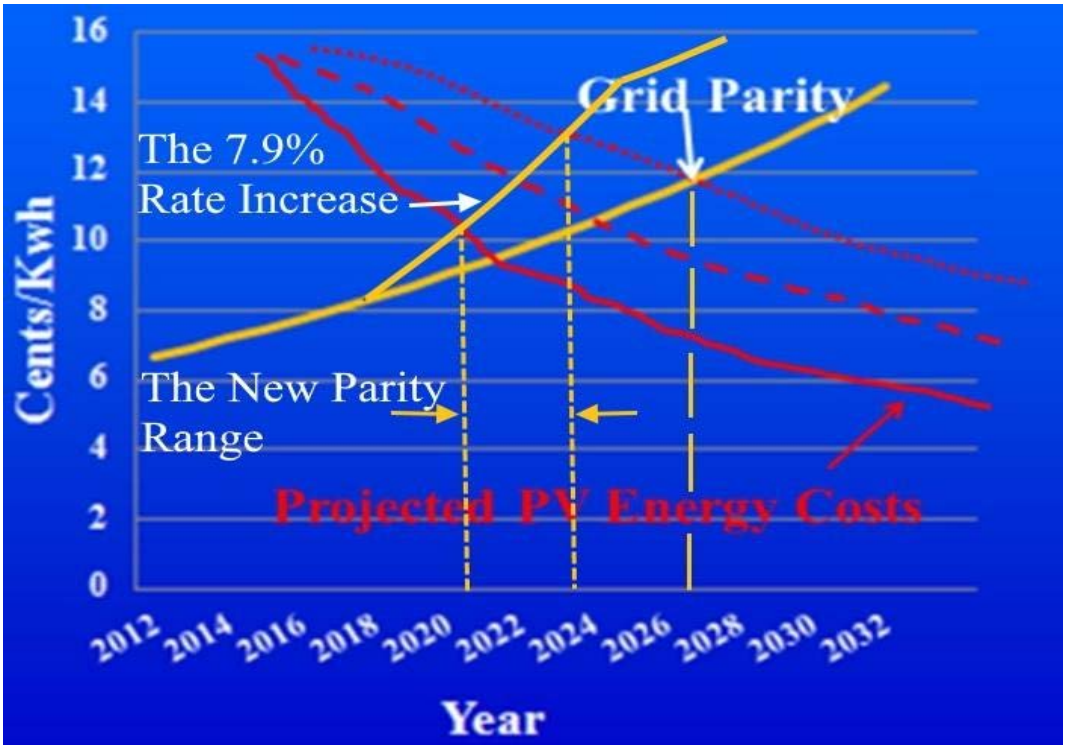
| City | Hours of Sunshine/year |
|---|---|
| Winnipeg | 2353 |
| The Pas | 2247 |
| Churchill | 1800 |
| Berlin | 1626 |
| Frankfurt | 1662 |
| Stockholm | 1821 |
| Paris | 1662 |
| London | 1633 |

Sources:

https://www.currentresults.com/Weather/Canada/Manitoba/sunshine-annual-average.php

https://en.wikipedia.org/wiki/List_of_cities_by_sunshine_duration#Europe

The impact range of years within which grid parity would be reached was presented by the Bipole III Coalition to the 2014/15 and 2015/16 General Rate Application[4]. Figure 1 of that brief is updated in Figure 2 below to reflect the 7.9% rate increase Application.




Source: From footnote[4] and Soft White 60 Corporation

Figure 2. Impact of the 7.9% electric rate increase on grid parity and the lowering cost of solar power

[4] Manitoba Hydro 2014/15 and 2015/16 General Rate Application to the Public Utilities Board, a brief submitted by the Bipole III Coalition 18 May 2015

Solar power is a disruption, particularly if it is coupled with batteries. This will have an impact on reducing domestic use of Keeyask energy.

Please note that the usual response to the possibility of an impending disruption is: No, it won't happen, no it won't happen, no it won't happen, etc., and then finally "yes, it is happening". What causes the change to yes? The "yes" occurs when the disruption develops into an obvious economic advantage, and then there is rapid acceptance. Today we all have computers of one kind or another. Four decades ago it was impossible to imagine that one day we would all have computers. Three weeks ago, in Australia, I saw an abundance of rooftop solar panels because electricity is very expensive there. As Manitoba electricity rates rise as forecast in Figure 2, we can expect increased use of solar panels, and possibly with batteries too.

Over the past decade, the demand for electric utility electricity has been dropping worldwide as shown in Figure 3. With this behind us, what is the future? Because of the challenges of load forecasting, nimbleness is required, particularly where it has not been evident over the last decade or more.

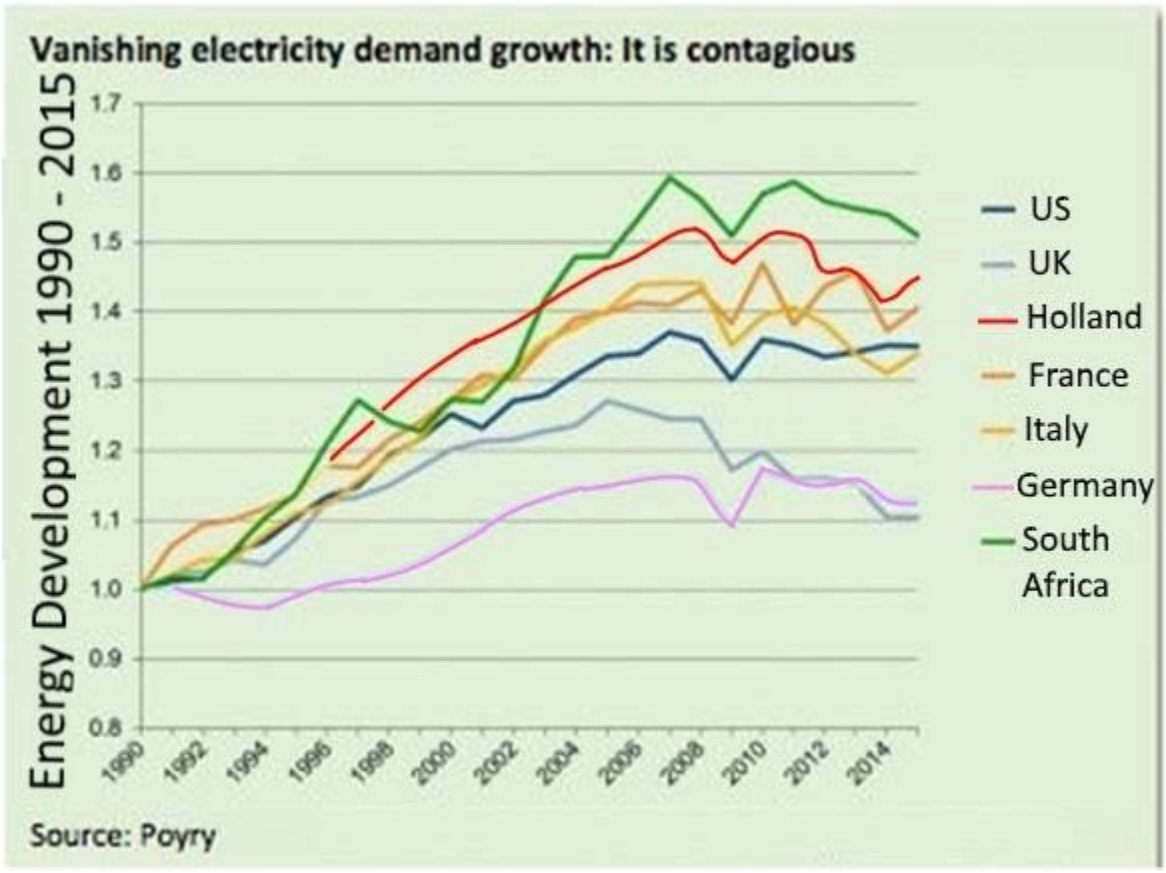
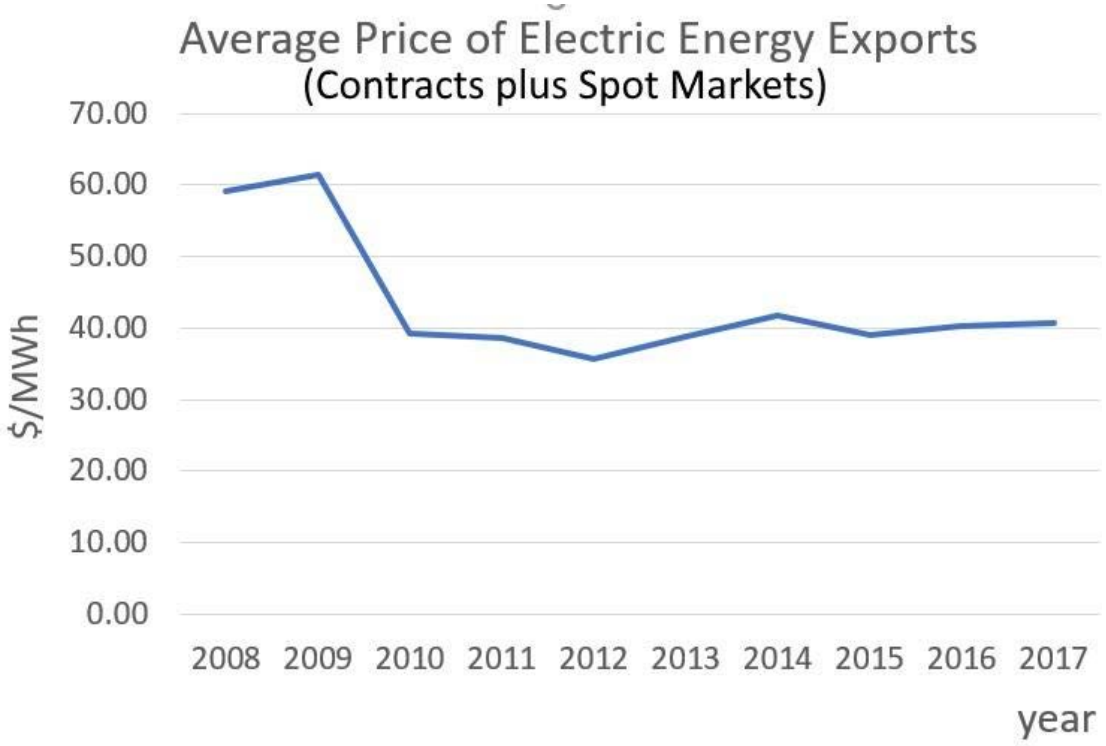



Figure 3: Comparative historic international electric energy demand

In parts of the US, electricity prices are near historic lows because of competitive energy markets. Demand for electricity remains stagnant while newer less-expensive generating facilities continue to come online. Manitoba Hydro's soft US export market is largely within the Midcontinent Independent System Operator (MISO) market area.

From the Manitoba Hydro Electric Board's Annual reports beginning from the year ended 31 March 2008 until the year ended in 2017, an average return on export for contracts plus spot sales can be determined by dividing the total export revenue by the total exported energy. The average price of all export sales year-by-year is shown in Figure 4.




Source: Manitoba Hydro Annual Reports from fiscal year ending 2008 to 2017

Figure 4: Manitoba Hydro's average price for electricity export markets in Canadian dollars

In examining Figure 4, there was ample indication in 2014 that export sales markets were soft. If Manitoba Hydro had been nimble, it could have delayed Keeyask and put contracts on hold until the project became economically viable. Instead, Manitoba Hydro put its trust in load forecasts that had a great deal of risk. It is rather like a battleship charging straight ahead through enemy waters without taking the maneuvers necessary to avoid torpedoes in a "damn the torpedoes, full speed ahead" command[5].

[5] A famous order issued by Admiral David Farragut during the Battle of Mobile Bay,

**Further Uncertainty in Load Forecasting with Increase in Electric Mobility:**

There has been much discussion recently about increasing the use of electric vehicles[6] to use more of Manitoba Hydro's increasing surplus of electricity within the province at a higher rate rather sending it subsidized by ratepayers out of the province at a lower price (Figure 4).

How much will electric vehicles (EV) be used in the province as we move into the future, and how will it impact our provincial economy? Past EV sales worldwide are shown in Figure 5.

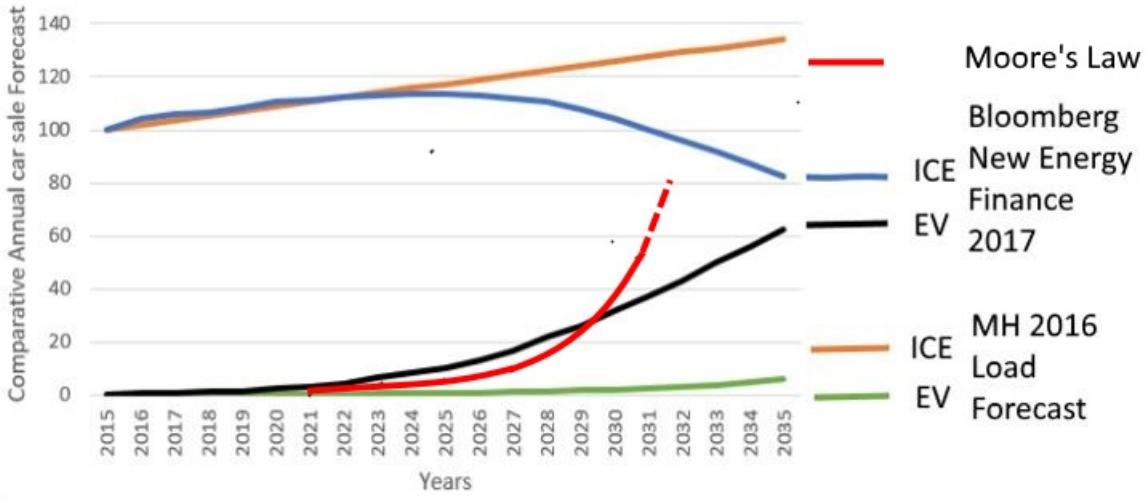

Source: http://www.ev-volumes.com/

Figure 5: Global growth of plugin electric vehicle (PEV) sales compared with Moore's Law

Moore's Law (beginning 1965) recognizes that the number of transistors per square inch on integrated circuits had doubled every year since their invention. This is true through to today, resulting in the increase in power and the reduction in size of computers. The computing power of a smart phone today would take up the area of a tennis court with a mainframe computer of the early 1970's. PEV sales are increasing faster than Moore's Law.

[6] One recent example: "*NDP proposes mass electric-vehicle conversion to prevent Hydro rate increases*", R. Altemeyer, Winnipeg Free Press, 24 January 2018.

Figure 6 presents Manitoba Hydro's forecast of EV sales in its 2016 load forecast[7], making a comparison with EV sales forecast in Bloomberg New Energy Finance[8]. These forecasts are presented along with Moore's Law and sales of regular gasoline burning cars with internal combustion engines (ICE). The total car sales in Figure 6 are normalized to 100 in 2015 using values calculated from EV share in Figure 5. It is important to appreciate that exponential growth does not continue forever. It levels out as the demand saturates, as was the case when color TVs came on the market. This is also referred to by futurists as the "S Curve".




Source Assembled from Bloomberg New Energy Finance 2017 and Manitoba Hydro 2016 Load Forecast

Figure 5: Difference in predictions by Manitoba Hydro for EV sales compared with Bloomberg New Energy Finance

Predicting EV load growth and its hydrogen mobility offshoot for transport trucks, busses and trains has a large amount of uncertainty adding to the need for Manitoba Hydro to be nimble in dealing with the uncertainty for electric energy generation and transmission.

**When Manitoba Hydro was Nimble in Planning:**

In past years, Hydro has demonstrated that, by being nimble and quick in its decision-making process, it has saved much money. Executives who were thoroughly familiar with corporate operation were able to react quickly, to changing circumstances, and adjust the direction of the corporation.

For example, in 1976, construction had started on Limestone. Two years later, the Executive recognized that the load growth was tapering off. Meetings were quickly arranged to make a

[7] Weather-adjusted values for Gross Firm Energy from Manitoba Hydro 2017/18 and 2018/19 General Rate Application Tab 7: Appendix 7.1 (2016 Electric Load Forecast)

[8] Bloomberg New Energy Finance's annual long-term forecast of the world's electric vehicle market, 2017

critical review of the need for the Limestone generating station. In a matter of a few weeks, the decision was made to halt construction. It must be said that there was much opposition within the corporation from the construction people who had a personal stake in proceeding. Nevertheless, engineering arguments prevailed and construction was stopped in 1978. The cost estimate for the Limestone station at that time, was $2.9 billion.

The station remained mothballed until 1985, at which time contracts were negotiated with the US utilities, and construction resumed. By now, the high interest rates of the early 1980's had declined, and it was a good time to resume construction. Limestone came in on-time and well under budget at $1.5 billion. During the main portion of the export contracts, Hydro received a total of $6 billion during a ten-year period. Limestone was paid for in 3 years.

It's interesting to compare those decisions with those made on the Keeyask station.

In 2008, Hydro decided that exports to the US were a good source of revenue to pay for the longer (and higher cost) rerouted Bipole III transmission project. The Public Utilities Board (PUB) reviewed Hydro's plans in 2014. During the intervening 6-year period gas prices had nose-dived and the US market had become soft. Hydro did not adjust its plans. In fact, the original plan before the PUB review was to build Conawapa, in addition to Keeyask. The PUB, not Manitoba Hydro, rejected the proposal to build Conawapa. Gas prices continued to drop, which meant the US market continued to soften. Hydro still did not react.

Two years later, in 2016, a new Board was appointed and hired the Boston Consulting Group to review Hydro's plans. Based on Hydro evidence, the Boston Consulting Group endorsed the plan. Circumstances relative to pricing of power to the US had dropped so dramatically that Hydro would not reveal their export prices during the PUB Hearing, nor since then to the public. The Bipole III Coalition believes the export prices are less than half of the average cost of producing Keeyask energy, a far cry from the lucrative contracts experienced with the sale of Limestone. It's perfectly clear now that, with the recent increase in Keeyask costs, the revenue shortfall will be catastrophic.

Hydro had ample opportunity to reassess the need for Keeyask and to stop construction, especially in light of the aggressive Demand Side Management program it was proposing in 2016. It predicted a saving of 1,288 MW in the next 15 years. Nonetheless, Hydro kept a straight course, like a battleship, steaming toward a financial disaster. Instead, it should have been nimble and quick, and adjusted the current disastrous plan.

**Flexibility in Building Bipole II**

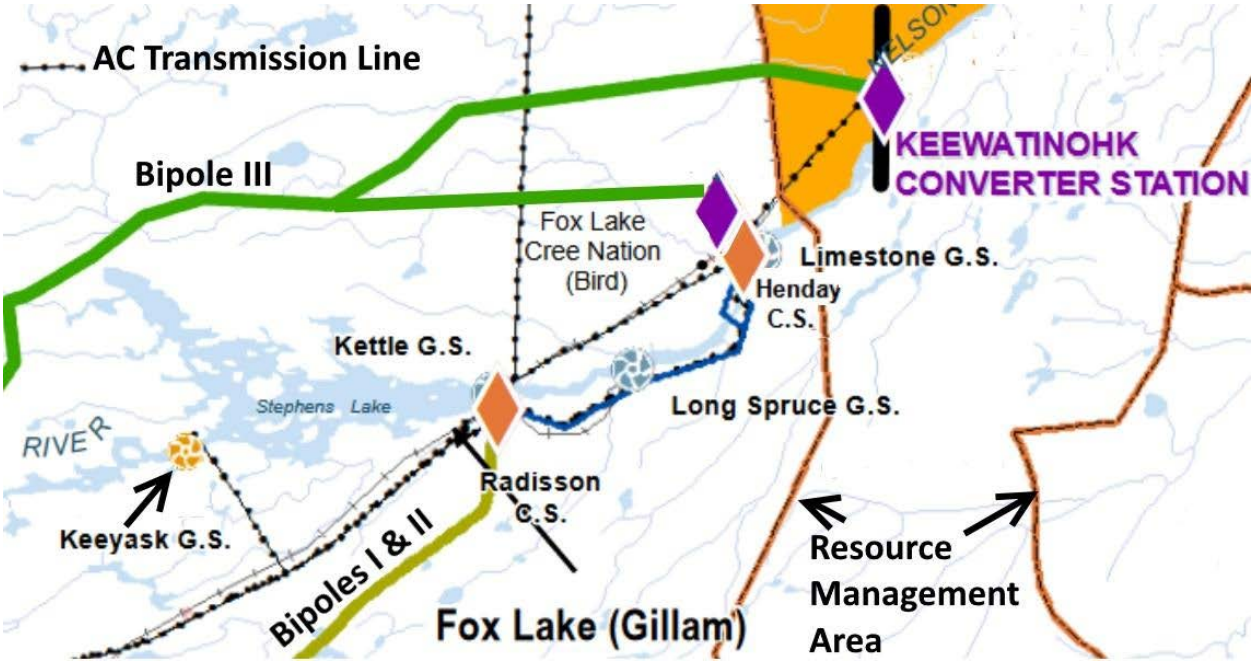
Bipole II was constructed along with the Limestone hydroelectric generating station. When Limestone construction was stopped in 1978, Manitoba Hydro quickly changed the construction schedule for Bipole II. Only half of its planned rating of 1,800 MW was completed. Stage 1 at 900 MW was operational from 1978, saving the cost of construction of the planned 1,800 MW. Then, when Limestone construction was resumed, the second stage of 900 MW was built. Bipole II was fully operational at 1,800 MW in 1985 to as Limestone construction commenced.

**Lack of Flexibility in Building Bipole III**

Now compare this with Bipole III. It was rated at 2,300 MW (2,000 MW plus 300 MW permanent overload) to accommodate the additional capacity of Keeyask (695 MW) and Conawapa (1,485 MW). In 2014, the PUB's NFAT report called for spending on Conawapa to be discontinued immediately and the project to be terminated. Manitoba Hydro had chosen to locate the Bipole III northern rectifier station at Keewatinohk near where the Conawapa generating station was to be located and about 100 km downstream towards the Hudson Bay from Keeyask. See Figure 6.

Construction began in 2013 with civil site preparation for the Keewatinohk converter station, construction power, as well as continued development of the Keewatinohk camp. The Keewatinohk AC switchyard contract was awarded in June 2014, near the same time as the release of the PUB NFAT report authorizing Keeyask's construction.

So, why did Manitoba Hydro continue with the Bipole III converter station at Keewatinohk so far away from generation when it could have been located closer to all the generation upstream on the Nelson River such as near Limestone? There is extra cost to construct five 230 kV AC transmission lines with a combined total length of about 160 km from the existing AC transmission collector system upstream. Not only that but sticking to the original plan added unnecessarily to the length required for the Bipole III transmission line which is being routed back upstream in a westerly direction past what will be the most easterly generation station. If close proximity to Henday converter station is a concern, then it could be located near Long Spruce.




Source: Derived from Manitoba Hydro Bipole III Route Map

Figure 6: Location of Keewatinohk converter station if it had been brought closer to generation

And a question to Manitoba Hydro: With the present location of the Bipole III converter station downstream at Keewatinohk, can the full 2,300 MW of converter capacity be fully used on the rare chance the Bipoles I and II transmission lines are both out of service? If not, what power can Bipole III bring south under such conditions, considering the redundancy argument relied upon to justify it?

**Recommendations:**

1. **The Manitoba Hydro grid should be changed to "open access" allowing competitive marketing of electricity between consumers and producers of electricity.**

2. **The Manitoba Hydro debt for generation and transmission should be assumed by the provincial government and not the ratepayers.**

Recommendation No. 1 would require changes to the out-of-date Manitoba Hydro Act. It would demand greater nimbleness in the generation of electricity. It would allow the development of microgrids providing free trade between consumers and producers of electric energy. Anyone with a solar panel on a roof would not have to sell the surplus daytime electricity to Manitoba Hydro, but could offer it to someone else if they can offer a better deal than Manitoba Hydro. The open access grid is not new, and is being adopted elsewhere. It is not the intent here to explain all the technical and financial aspects of an open grid, but two aspects become important:

i. Any electric energy transactions over the grid would require a tariff for its use, also known as a "wheeling charge". This would allow the transmission portion of Manitoba Hydro to maintain and develop the grid.
ii. The open access grid would provide needed competition to the unfettered monopoly of Manitoba Hydro with its inability to adjust quickly to changing times.
iii. Manitoba Hydro's existing generation including Keeyask would have to compete for provincial energy sales with local generators from rooftop residential solar plants with batteries to new large wind and solar farms.

Recommendation No. 2 would protect the interests of all ratepayers. It would be more equitable for those on low income because the graduated tax system puts a lower tax burden on the poor consumers of electricity and a higher tax burden on the more affluent consumers of electricity. This is how some other electric crown corporations in Canada are structured as indicated in the presentation to the Panel by Morrison Park Advisors on 15 January 2018[9]. Additional points are:

i. Moving debt to the provincial government would allow for a financial reorganization within Manitoba Hydro while providing a gentler pay down by the

[9] Presentation by Mr. Pelino Colaiacova of Morrison Park Advisors to the GRA Public Hearing, 15 January 2018 as recorded in the transcript, pp 4840 - 4856

province at provincial debt rates, a move that could spread out the time and also help with the credit rating agencies.

ii. The transfer of debt could be treated differently as to the provincial budget and deficit, as a retroactive to end of either last year or after this year-end.

Taking away massive rate hikes may well save the fertilizer plants, industry generally and the economy. Electricity rate increases would be limited to the cost of living increases.

**Conclusion:**

Continuing forward in an archaic and now inflexible electric utility monopoly that is destroying the "Manitoba Advantage" must cease, and dramatic surgery applied.

**About the Bipole III Coalition:**

The Bipole III Coalition is a grass-roots organization of concerned citizens established in November 2010 to promote public awareness among Manitobans that a route for Manitoba Hydro's planned Bipole III transmission line on the east side of Lake Winnipeg would be superior to the route chosen on the west side of the province. Soon after its establishment, the Bipole III Coalition broadened its mission in order to promote public awareness of its concern that Manitoba Hydro's corporate plan is not very well aligned with the interests of its ratepayers and not even with the interests of the citizens of Manitoba. It is concerned that Manitoba Hydro's corporate plan is not very well aligned with market challenges and opportunities. The Bipole III Coalition is not affiliated with any political party.

The presenter, Mr. Dennis Woodford, is a Director of the Bipole III Coalition.