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Pipe, Dam and Electricity Dreams

Burdening Manitoba's Next Generation

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Executive Summary

A decision will shortly be made about whether to build the Keeyask and Conawapa hydroelectric dams and the associated Bipole III transmission line, which could cost Manitoba billions of dollars. This paper argues that, if approved, this will burden the next generation with debt and higher utility prices. The paper reviews the development of the Manitoba electricity sector as well as how the interaction of gas and power markets is changing decades-old realities. It includes examples from other jurisdictions where government involvement in electricity has led to unintended consequences, thus providing a cautionary tale. By showing historical electricity demand forecasts that vastly differed from reality, as well as describing the impact of disruptive new technologies, it illustrates the fragility of demand and the sales assumptions made by Manitoba Hydro to justify investment. The paper concludes by proposing six options that favour prudence rather than pipe dreams and new dams.

By showing historical electricity demand forecasts that vastly differed from reality, as well as describing the impact of disruptive new technologies, it illustrates the fragility of demand and the sales assumptions made by Manitoba Hydro to justify investment.

1. Electrical engineers and gold-plating

Engineers have made important contributions to Canada, but checks and balances need to be in place to limit overbuilding and gold-plating infrastructure.

Engineers have helped build Canada. Their work on our impressive national infrastructure literally connects the country while enabling high-quality lifestyles. It is unfortunate that their efforts have been overlooked at times, with difficult projects viewed in retrospect as either inevitable or expected.

As Canada developed and modernized, engineering became increasingly specialized. There may now be more software engineers than there were at Confederation, but the application of scientific principles to create and build new machines and infrastructure remains constant. Also constant is the engineers' determination to build the best possible machine, tractor, tool, car, Blackberry or hydroelectric dam. While engineers pursue perfection, often attempting to create something over and above specification, there usually is, as a counterbalance, the moderating influence of entrepreneurs and businesspeople. They seek profit and generally cannot afford to include every design tweak. Consumers benefit from this process as innovations are taken to market and become progressively cheaper.

Although the private market limits over-engineering, political leaders can become enthralled by grand schemes and pursue megaprojects. Too often, these projects suffer cost blowouts and do not achieve their objectives. When this happens, taxpayers pay more for services or bear additional taxation to make up the losses from these failed projects. Sometimes, the blame for conceiving large and complex undertakings is placed unfairly on the engineers, whose aim is to solve a technical problem and achieve the desired result, with the cost seen as a separate issue. Often, it is more important to focus on the processes and decisions of politicians who commit to these projects even if under the cover of the now-ubiquitous advice of independent experts.

In the electrical sector, and particularly for electrical engineers, there is too frequently a desire to build the most-sophisticated, complex and technically challenging electricity grid and generation plant possible. After all, this is why most electrical engineers spent four or five years in university. When proper cost-benefit analyses of new projects are not applied, the result of ambitious plans can be what is termed "gold-plating." As the name suggests, gold-plating is the inclusion of expensive but unnecessary elements to achieve a specific non-economic goal. Unfortunately for the public, it is difficult to unpack the jargon, technical terms and incomprehensible nature of new investments in the electricity sector to determine if they are to pay for gold-plating or for a necessary service.

This paper will review the proposed Keeyask and Conawapa hydroelectric dams and the associated Bipole III transmission line and argue that Manitoba's taxpayers and consumers (of electricity) will be burdened for at least a generation if this gold-plating of the system is permitted to proceed.

2. The electricity sector in Manitoba: Past, present and future

The Manitoba electricity sector has had an interesting past that still casts a long shadow over current developments.

Introduction

To better understand the current policy debates about electricity in Manitoba, it is useful to briefly review the historical development of Manitoba's power infrastructure. Most decisions around new investment in electricity assets involve legacy systems and infrastructure. Looking at existing transmission and generation reveals as much about the history of a region as the actual power system does. While not unique to Manitoba, decisions made today could result in the building of assets with expected 50- or 60-year service lives that will affect service and rates well past 2060.

Before delving into the past, it is helpful to note the current state of the Manitoba electricity industry. In summary, the vertically integrated, government-owned Manitoba Hydro dominates it. Manitoba Hydro is a low-cost producer of electricity with the majority of its depreciating assets having been built decades ago, which resulted in low power rates for Manitobans and an expectation that the low-cost/low-rate paradigm would continue.

From a historical perspective, there were two distinct phases in Manitoba's electricity industry:[1] the pre-1961 emergence of an electricity industry and the post-1961 establishment of Manitoba Hydro and its "big build" of hydroelectric assets.[2]

As of 2014, there is a potential turning point in the trajectory of the sector: the beginning of a transitional phase from a low-cost to a high-cost power producer. This will occur if the proposals for a large new build of additional hydro and transmission assets proceed. The implications for taxpayers and electricity users are significant.

Phases in Manitoba's Energy History

- **Pre-1961:** Experimentation and the emergence of an electricity industry;
- **Post-1961:** The establishment of Manitoba Hydro and the initial "big build"; and,
- **2014 onward:** The transition to a high-cost producer?

Early Years

There are a number of excellent histories on the development of Manitoba's electricity assets. While outside the scope of this paper, the "History of the Electrical Industry in Manitoba" by David S.G. Ross (Manitoba Historical Society's *MHS Transactions* journal) succinctly captures developments up to 1961.[3]

Experimentation characterized this period as multiple entities sought to develop new and independent projects that resulted in a gradual expansion of electricity services

throughout the southern and central areas of the province.

During the 1950s, the predecessor entities of Manitoba Hydro struggled to supply the significant growth in demand. This meant that upon the creation of Manitoba Hydro, the focus was on building new assets, with the expectation that increasing demand would quickly utilize the initial excess capacity.[4]

The emergence of Manitoba Hydro

The modern entity of Manitoba Hydro came into existence in 1961. With the emergence of Manitoba Hydro, there was a consensus for the need to build new hydroelectric assets to meet significant post-war increases in annual electricity demand. The conditions were unique in the modern history of the province and encouraged an ethos of "build it and they will come." While perhaps valid at the time, the extended period of economic and population growth was not standard and is, unfortunately, unlikely to be repeated.

With the consolidation of predecessor organizations and an emphasis on planning and building successive new hydro projects, the modern identity of Manitoba Hydro was formed.

This period of new physical electricity interconnections—to other provinces and the United States—coincided with significant growth in demand and the availability of financial assistance from the federal government. Accordingly, there was logic in building large generation assets.

The combination of factors meant that the seemingly large overbuilds would provide only a few years of excess production as rapid demand would quickly utilize the excess capacity. The exploitation of Nelson River sites and new interconnections provided options to Manitoba Hydro's system operators, allowing for the addressing of system issues while opening up new markets. This set in process a major period of building, increasing Manitoba Hydro's total generation capacity.

With the exception of the 200 MW Wuskwatim Generating Station, there were no large-scale investments in new hydro assets since Limestone generation station in 1989-1990. The operating context of Manitoba Hydro began to change from 2008.

As indicated in the initial discussion about gold-plating, many of the projects developed by Manitoba Hydro's engineers were at the forefront of technology, especially given the remote landscape and the long distances the transmission lines covered. Unfortunately, these successes instilled a view of the benefit of continuous, sequential expansion of new hydro and transmission assets (supposedly validated by experience). The security drawn from experience is not, however, a sure indicator of future success.

No one doubts the technical skills that were accumulated over the decades by Manitoba Hydro, yet the previous positive outcomes that resulted from a low-cost power system are unlikely to be replicated, especially if provincial demand growth slows and/or export markets disappoint.

Cheap, reliable electricity

Manitoba Hydro's electricity rates are among the cheapest in North America. The annual Hydro-Québec survey provides hard data that shows that Winnipeg residents enjoy the lowest electricity rates in most customer categories.[5]

Having low rates has been a source of considerable pride and has given the province a competitive advantage. With the low rates (bills cover rates and volume of consumption, the latter affected by the severe cold weather in winter) brought about by aged and largely depreciated assets and a historical desire for fixed, flat tariffs, there is a sense of complacency that the low rates will continue. However, these rates are the result of a number of factors and history, particularly Manitoba Hydro having a suite of legacy hydro assets that could soon be joined by new infrastructure that is much more expensive.

Aside from the ability of Manitoba Hydro to access reasonably cheap financing (through provincially guaranteed borrowings), it is arguable that further efficiency gains are not possible.[6]

Excluding the contentious issue of privatization, the disaggregation of parts of the business and a tougher regulatory system could improve productivity and result in lower future power rates than otherwise will likely develop as new infrastructure drives up amortization and financing costs.

If the proposed Keeyask and Conawapa dams and the Bipole III transmission line proceed (discussed later in the paper) and international sales do not materialize (volumes and prices) as now forecast, the new higher-cost base will drive up rates more than the 120 per cent over 20 years currently forecast.

The rest of this paper focuses on the need for Manitoba to ensure a low-cost electricity supply, rather than empire building and gold-plating the system.

3. The true costs of government intervention in the electricity sector

When government directs, regulates and runs the electricity sector, the costs are higher than they would be under private ownership, and they are ultimately borne by citizens and ratepayers.

Introduction

Across the world, governments on all sides of the political spectrum have long been involved in the generation and delivery of electricity. During its early stages, the industry was mainly operated and owned by entrepreneurs who were in the business of selling a service, not just kilowatts.[7] Shortly after this initial period of rapid innovation and experimentation, these new power systems shifted toward large public and private regulated monopolies over set geographical regions. In some countries, such as Canada, the bulk of electricity utilities ended up in government hands.

There is nothing inherently more efficient about government ownership; many government interventions in the industry have resulted in increases in the cost of electricity for ratepayers.

Context

The modern electrical system emerged in New England with the likes of Thomas Edison and Samuel Insull battling to set technical standards, capture market share and define the nature of the industry.

This period of innovation occurred between the 1890s and the 1920s. In the state of New York during the 1920s, Governor Franklin Delano Roosevelt promoted the idea that the electrical industry was endowed with a public interest. Eventually, following public debates, government emerged as a major decision-maker, if not the direct owner of the industry.

As governor, for the reason of public interest, Roosevelt promoted the creation of regulatory bodies based on a defined geographical region. The following points were the basis for this approach:

1. To prevent unnecessary duplication of services in any area and to prevent cut-throat competition that would bring ruin to some and thus impose added difficulties on others;
2. To remove any suggestion of favouritism between one segment or class of users and others, as well as to secure adequate service for as many people as need it; and,

3. To establish and approve rates.[8]

Given the above principles, Roosevelt maintained that ownership and operation of public utilities—directly or indirectly by government—would ensure the retention of electric power for the benefit of citizens, making it available without discrimination and providing for a reasonable rate of return on the investment.

These ideas were carried through to the New Deal as a response to the Depression, when Roosevelt was the U.S. president. Characteristic of the New Deal and in line with Roosevelt's general thinking was the creation of the Tennessee Valley Authority in May 1933.

It provided navigation, flood control, electricity generation, fertilizer manufacturing and economic development within the region. This organization linked public ownership, economic development and the electrification of rural regions and became a reference point for many Western governments' electricity systems in the 1940s and 1950s.

The U.S. experience influenced the creation of Manitoba Hydro and similar developments in other provinces. New Deal thinking remains remarkably powerful in 2014, with the sentiment of Roosevelt's period as New York governor still framing contemporary electricity debates. This has effectively locked government into a dominant role in the electricity sector and a de facto partner in economic development, however broadly defined.

These arrangements may have been beneficial during the post-war boom, but in a low-demand growth era where consumer products are fundamentally changing the nature of producers and consumers of electricity, heavy government involvement in the sector may actually be pushing up the cost of power, particularly if government and its captive utilities do not prudently invest in assets.

Costs and prices

Electricity has both a cost and a price, and they are not always equal. The cost is the sum of the economic processes that are required to get electricity to the end consumer. Simply put, this is the wages, interest, taxes and the amortization of built or purchased infrastructure (and a number of other inputs) that an electricity provider needs to expend to meet consumer needs. Price, conversely, is the amount the consumer pays for the product. In the private sector, the cost must be less than the price: The difference is profit. If cost exceeds price, bankruptcy is the result.

The price paid by consumers for their electricity is a combination of consumption and rates, the latter generally the result of a regulatory or political process. At times, the cost of power is more than what is paid by consumers. This can result from a direct subsidy established by government, implicit or explicit debt guarantees (provided to lower the cost of capital for utilities) or more-complex regulatory mechanisms involving some form of taxpayer transfer to the producers of electricity. In economic terms, it is more efficient for the cost and price of electricity to be closely aligned, ideally in a private setting with a profit component to attract and encourage investors.

Within Manitoba, electricity rates have been low for some time. There are three primary reasons for this. Rates are set based on the regulator's determination of how much revenue is required to meet the annual costs pursuant to generally accepted principles of cost accounting; the average infrastructure is old (meaning low annual amortization and interest expense); and the amount that is required to provide the utility with sufficient reserves to satisfy the debt market. Even if the price were kept down while the cost base of the infrastructure increased due to unnecessary overbuild, government would have to make up the shortfall. If it did not, the credit market would not finance further infrastructure.

For this reason, it is important to always look at the true cost of electricity rather than simply the price paid by a particular set of consumers.

Lessons from other jurisdictions

Recent government involvement in Canada's electricity market has weakened the energy industry. In particular, since the green movement emerged and favoured particular generation sources (such as wind and solar), governments responding to popular political pressure have made expensive and unnecessary decisions about the power sector.

The ongoing fallout from the cancellation of new natural gas plants in Ontario is representative of the significant distortions of the electricity sector that can arise. In a report released on October 8, 2013, the Ontario Auditor-General, Bonnie Lysyk, estimated the cost to the province for the cancellations could reach $1.112-billion. Another example is Ontario's mandating of solar power contracts at prices well in excess of cost. The imposition of renewable targets, the effective banning of investment in new coal plants, the closures of existing coal plants and the general schemes under the green banner further add to cost of electricity.

Internationally, Spain is a jurisdiction where the government intervened in the electricity sector and ended up destroying employment and costing taxpayers when it aggressively promoted renewables and new green jobs. Through a variety of subsidies and regulatory mechanisms, the Spanish government sought to expand the use of renewable energy and, with it, create a new industry. The government failed to achieve its objectives and caused a negative impact across the entire economy. A major study on the Spanish renewable experience noted: "The price of a comprehensive electricity rate (paid by the end consumer) in Spain would have to be increased 31% to be able to repay the historic debt generated by this rate deficit mainly produced by the subsidies to renewables, according to Spain's energy regulator."[9] (Any mistakes are in original.)

Germany, a much larger economy than Spain, is adapting to the unintended consequences of renewable subsidies and the closing of its nuclear industry, which was prompted by a populist response to the public perceptions of the tsunami-affected Fukushima nuclear plant. In dispassionate terms, *The Economist* captured these tensions:

> *"Renewable energy has grabbed a growing share of the market, pushed wholesale prices down and succeeded in its goal of driving down the price of new technologies. But the subsidy cost also has been large, the environmental gains non-existent so far and the damage done to today's utilities much greater than expected."*[10]

The German experience is particularly relevant to Manitoba, as it is an example of the government effectively mandating the energy mix to achieve a stated environmental outcome, but one wherein it could not influence the price of international commodities.

The result of government intervention in other jurisdictions and, at times, in the direction of the electricity sector needs to be analyzed carefully. This is also true for Manitoba, and it should be factored into existing debates over new hydroelectric dams and transmission lines.

Do not get left with the bill

Ordinary citizens and industry pay for electricity. As such, keeping the cost and price of electricity low in Manitoba is a cause worth fighting for on both social welfare and economic grounds.

Many have argued that the public sector is best suited to owning and operating electricity utilities because it can access cheap capital, and it has a long-term assured outlook. These claims are both true but do not mean that all the investments made by government-controlled utilities are either prudent or will be beneficial for ratepayers and the overall economy over the long term.

One obvious development that undermines the need for large, new capital investments in hydroelectric power plants is the cost-effective expansion of the electricity sector that is possible when the natural gas and power markets converge.

4. Interaction between electricity and gas markets

Electricity and gas markets interact much more than they have historically, and this interaction could influence Manitoba's energy mix through to the 2020s and 2030s.

Introduction

Traditionally, electricity and natural gas have been viewed as two separate markets. Natural gas was generally restricted to the role of producing peaking power (used when demand is at its highest for a limited amount of time) rather than base load generation (generally running consistently except for maintenance), particularly in Manitoba and the U.S. market, which is a destination for Manitoba Hydro exports. However, contrary to the experience in Manitoba, there has been a steady increase in the use of natural gas for electricity since 2008.

The general trend to natural gas-fired generation is attributed to two factors: the lower carbon emissions of natural gas compared with coal or oil and the increasing use of technology to extract gas from abundant shale deposits.

Natural gas has been termed a "transition" fuel in the general shift toward a low-carbon economy. While hydro will dominate Manitoba's electrical sector for the indefinite future, its electricity interconnections with other provinces and the United States mean that the shift to gas and the expansion of shale gas production occurring in other jurisdictions will influence Manitoba Hydro's operating context. The increased reliance on natural gas in Manitoba Hydro's export markets will reduce its opportunities.

A shift to gas

In 2011, the International Energy Agency published a report titled "Are We Entering a Golden Age of Gas?"[11] The study considered the long-term outlook for natural gas and presented a scenario in which the global use of natural gas rises by more than 50 per cent from 2010 levels and accounts for more than one-quarter of the global energy demand by 2035.

Aside from lower carbon emissions when compared with coal, gas is favoured within electricity markets for a number of other reasons. Gas power plants are cheaper per unit of power generated than coal is and much cheaper than nuclear power is.

Furthermore, with increasing restrictions (and effective bans) on new coal power plants in some jurisdictions, and in places where hydro and nuclear are not available, gas tends to be the preferred option for both base load and peaking plants.

With respect to Manitoba and its total commitment to hydro generation, natural gas generation would provide diversity of supply, as droughts occur regularly and

they can reduce hydro generation by 40 per cent from the average levels. Without no diversity of supply, Manitoba relies on imports from the United States, imports generated largely by coal-fired plants.

Convergence

With heating, power and other industrial processes relying on natural gas as a competitive fuel source, electricity and natural gas markets should be viewed as part of a larger energy market. As the price and availability of natural gas change, so do the choices for electricity generation.

With natural gas generation employed for peaking and, increasingly, base load generation, if the cost of gas increases so will the cost of electricity, including the wholesale export-import component of the electricity market. Gas is also important as part of the energy mix, as it can help accommodate feeding more wind on to the grid because of its ability to ramp up and ramp[12] down quickly following variances in the wind. Conversely, traditional coal plants lack this flexibility. As more wind generation comes online, the demands on gas may increase, exposing the electricity sector more often to the vagaries of wind and the fluctuating spot price of natural gas.

The expansion of shale gas across various basins in the continental United States and Canada has accelerated the general shift toward natural gas as the fuel source for the generation of electricity. As recently as five to 10 years ago, there was an expectation that a natural gas shortage would develop and we would require international imports of liquefied natural gas (LNG) and that North America would enter a period of higher natural gas and electricity prices.

The situation and forecasts have changed radically, and rather than importing natural gas, the United States, and likely Canada, will soon be exporting LNG. Due to the public preference for domestic consumption of gas and the new technologies that are making extraction of tight gas and shale gas now economically possible, there has been a structural change in the U.S. power market. Cheap natural gas is a reality, even if it does not remain at recent record lows, and utilities are taking advantage of this shift.

The impact of convergence on Manitoba

Part of the success of Manitoba Hydro came from its ability to export surplus power to the United States. Prior to domestic demand being able to be sufficiently large to utilize the excess capacity (now 30 per cent) after the commissioning of each new dam export markets provided a revenue stream. As electricity and gas markets converge, this option may no longer be available. A ready example of the change in prospects is the Wuskwatim dam, which came into service in 2012. It was built as an export plant, but lower spot export prices have resulted in only one-third of its per unit costs being met by the export sales price, thus producing annual losses of $100-million, which represents a prospective domestic rate increase of 10 per cent.

Manitoba Hydro is an associate member of the regional transmission organization known as the Midcontinent Independent System Operator (MISO). As an exporter of power to MISO, the largest of the U.S. transmission networks, Manitoba Hydro is and will be influenced by the energy mix in this larger MISO region. In a study by consultants at Brattle Group, commissioned by Manitoba Hydro for a Needs For and Alternatives To (NFAT) regulatory test,[13] it was noted that natural gas would increasingly displace coal and become more central to generation-cost benchmarks and electricity prices in the coming decades.

The Brattle study discusses a number of factors that could reduce current generation capacity and subsequently increase demand for Canadian power in the United States. The potential closure of older coal plants in order to meet increasingly strict emission guidelines may offset the growth in supply from new wind, solar, and gas generation. That said, coal is expected to play a large role in U.S. generation for many more decades.

However, extracts from the Brattle study make clear that there is going to be a larger supply of natural gas generation.

> *"[Natural] gas should be plentiful for decades, able to accommodate new demand (fuel switching, industrial, transport). Even strict regulation of fracking would add only modestly to gas prices; around $0.50/MMBtu."*[14]

The new supplies of natural gas and the shift to this fuel source as the low-cost power option has changed the economics of the traditional export destinations of Canadian hydropower. Hydro-Québec is dealing with this issue because New England markets have transformed significantly due to the shale gas boom that is centred in Pennsylvania.[15]

What next?

The electricity sector is often confronted with questions concerning the future of the industry.

This analyst has spent a great deal of time working on the impact of new technologies on the economy, technologies such as electric vehicles and solar panels as well as various international developments. Through this research, it has become clear that forecasts or predictions (to be discussed in depth in the next section) are fraught with problems.

It is difficult to ascertain the direction of the electricity sector (supply and demand as well as pricing are in question), and definitive answers are not possible. Perhaps the convergence of gas and electricity markets was not unforeseen, but very few predicted the rapid expansion of tight gas and shale gas as well as the flexibility of electricity markets to incorporate large, new supplies of natural gas that fuel new generation stations.

5. Disruptive new technologies

New technologies and processes constantly change the electricity landscape.

Introduction

New technologies and competitive forces will result in major changes in the electricity sector. Even though the industry is heavily regulated, households and businesses are still able to utilize new consumer goods that change how electricity is used.

A useful comparison is the telecommunications sector, which has experienced rapid change over the past two decades, moving from copper wire to smart phones in a remarkably short time. It is possible that the combination of developments in information technology, the automotive industry, GPS and consumer goods will open radical new options for electricity consumers.

This could mean that that overall demand patterns and usage may change, resulting in different needs for new generation and electricity assets. Surprisingly for many observers, per capita consumption of electricity has fallen over the last five years in the United States, and the decline is not just because of the economic slowdown of 2008 to 2009.

Black Swans

In his book *The Black Swan,* Nassim Taleb, a former derivatives trader, popularized the concept that unforeseen and unknown events can cause major shocks to the financial system as well as to individual lives.[16] One obvious Black Swan event was the September 11, 2001, terrorist attacks in the United States. They were completely unexpected, and the notion of using commercial aircraft for suicide missions was not anticipated by law enforcement agencies.

The concept of Black Swan events has been applied to several different fields and is relevant to the power sector. In all likelihood, a Black Swan product or process will fundamentally change the Manitoba electricity sector. From a consumer perspective, such changes are generally always positive and either improve the end-user experience or make a service cheaper.

A Black Swan event may mean that those building and running the power sector may have to offer a radically different service.

Contenders for disruption

Many contenders for a Black Swan technology or process could sweep through Manitoba and be quickly adopted throughout North America, including in the MISO market. This event will likely not be on the following list. The purpose of the list is not to make predictions but to indicate how some technologies could or most likely will cause disruptions to the long-term, 67 years out, plans of Manitoba Hydro.

- **Electric vehicles:** The idea of charging a vehicle so it can run off a battery is a reality. As electric vehicles (EV) enter the mass market, the real issue is the take-up rate. Should this be faster than expected, electricity usage may change, potentially affecting periods of peak demand. Coupled with smart meters, it is possible that EVs could be used to assist the functioning of the grid and be utilized temporarily when connected.
- **Cheap batteries:** Linked to EV developments is the prospect of radically cheaper batteries. A proportion of the electrical grid (transmission, distribution and generation) is built for peak consumption periods. If the cost of batteries were reduced, they could be deployed at a neighbourhood or even a household level to flatten the demand for electricity. This would mean that a significant number of new electricity assets could be deferred and that assets now in operation could be used more efficiently.
- **Energy conservation:** The idea of negawatts[17] is essentially one of shifting or reducing electricity demand at particular times of the day or year or even avoiding the consumption of electricity where possible. The ability to remotely operate a range of loads from EVs to dishwashers and hot water systems is already possible. What has changed is the enabling technology such as smart meters, smart appliances and powerful real-time system management computers. This is akin to the introduction of the Blackberry and the popularization of using smart phones for accessing e-mail. The novel application of new software helped to unlock a practical use for the cellphone. Similarly, aggregating consumer products or selling a bundled product and/or service that can be turned off at peak load times could unlock new market opportunities.
- **Mini-generators:** In most utilities, economies of scale have favoured larger generation plants for greater efficiency. It is possible that smaller hydro[18] and wind-battery combinations and possibly mini-geothermal will eventually become cost competitive. This would fundamentally change the business model of utilities, as they could add small modular plants as demand increases, then relocate as loads decline or move. These conditions have occurred in manufacturing where long runs, large plants and long lead times are no longer necessary. Batch production, flexible output and small scale are possible and profitable.
- **Household insulation:** Something not directly related to the power sector may affect it the most, such as a new building-insulation product that reduces the demand for winter heating. New homes are certainly more energy efficient than older homes are, but if there were an insulation product that could be easily retrofitted and would save money on winter heating, consumers would likely employ

it quickly. There would be no need for a government program or green scheme to replicate such a situation in thousands of Manitoba homes, and load forecasting could significantly change as a result. Currently, electricity heats 35 per cent of Manitoba households.

As mentioned, a Black Swan event may be simple and spread quickly. It need not necessarily involve Manitoba directly; it could affect U.S. markets where Manitoba Hydro is expecting to sell large amounts of excess electricity. In other jurisdictions, Black Swans affecting electricity demand have ranged from cheap air conditioners to economic booms and busts. New technologies will always disrupt traditional systems, and the electricity sector has been insulated from radical change for a long time because of its status as a regulated monopoly industry. In general, the main Black Swan events have been large, unexpected, new demand spikes. In the 2020s and 2030s, it could be the exact opposite if EVs or perhaps household insulation and mini-generators allow consumers to delink from the grid. A shock driven by a sharp demand drop would prove even more difficult for utilities to deal with and would disrupt their business models. In the Manitoba context, a true Black Swan event need not occur to result in disruption. If electricity sales to the United States either do not happen or are entered into at prices well below the cost of production, the outcome for consumers could be economically damaging and could potentially even affect population growth.

6. Demand forecasting: Pitfalls and international experiences

Forecasters are often inaccurate, and excessive reliance on predictions more than 10 years into the future are fraught with risk and complications.

Introduction

Forecasting is a difficult undertaking. At times, too much weight is placed on projections, which sometimes involve linear extrapolations of current trends or optimistic assumptions based on contemporary thinking. Occasionally, projections are remarkably accurate, but it is not prudent to commit to a project due solely to a forecast.

Manitoba's experience regarding commercially successful decisions based on forecasting for future energy demand and the cost of supply has been historically inconsistent.

Forecasts and investments

Forecasts play an important role in investment decisions.

In the oil industry, the deployment of capital amongst the major private companies involves painstaking models, market analysis and strategic risk. Generally, there is a robust decision-making process, especially when there are outside shareholder funds involved.

Within the electricity sector, new investments made by publicly owned utilities are generally subject to a regulatory test to ascertain the need for new assets. In Manitoba, this is the Needs For and Alternatives To (NFAT) regulatory test.[19]

Promoters of new projects must show the demand growth and/or reliability requirements that justify investment so that the costs can be recouped from electricity users. Unfortunately, in the case of Manitoba's current NFAT process, the government's Terms of Reference leave critical areas for examination off the table, producing a flawed process.

Manitoba's plans

The promoters of developing the Keeyask and Conawapa dams and Bipole III transmission line allude to the "expensive and controversial decision"[20] made in the 1960s and 1970s to develop hydroelectric power along the Nelson River. The eventual economic success of those previous projects is transferred on to future projects.

On the main page of Manitoba Hydro's website there is pictured a presumably Manitoban woman beside the tag line "It's our generation's turn to invest." Seemingly, the utility has concluded that making major new infrastructure investments will always be economically successful and in the long-term interests of all residents of the province. Also on its Web site under "Electricity Exports" is the statement, "Our forecast total export revenues are $16 billion over the next 20 years; $29 billion over the next 30 years."[21]

Relying on these ambitious forecasts may expose Manitoba electricity users to major and unnecessary rate hikes if the projects proceed as planned and the optimistic forecasts do not materialize. Even with the assumption that the export forecasts are fully realized, the utility expects forecasts above inflation rate hikes. Some critics suggest that in the end, rates will triple over the next 20 years if the projects proceed as planned.

An investigation into the Manitoba Hydro documentation for the NFAT regulatory test reveals that the basis for the utility's estimates of exports may be difficult to substantiate, let alone realize. Manitoba Hydro engaged the respected Brattle Group to prepare a "market overview for the US market for the next 20 years and beyond."[22]

The work by Brattle captures the key trends in the U.S. energy industry and reviews future demand patterns, which form part of the basis for Manitoba Hydro investing $34-billion (which represents half of Manitoba's current Gross Provincial Product).

Brattle discusses the shale gas boom and natural gas displacing coal as the major reference point for wholesale energy prices. Brattle is correct, and its work in this area is meticulous.

The document prepared by Brattle (plus a number of other reports filed by independent experts who were engaged by interveners for the NFAT process) reviews in a comprehensive manner a range of developments and factors that could potentially exact upward pressure on (U.S.) power prices and favour cheaper Canadian hydroelectric imports.

The key is the rate and speed of coal retirements and how or if climate policy will favour non-emitting generation types such hydro, wind, solar and nuclear (of which hydro is the cheapest). U.S. opportunities for more hydro dams are very limited. Wind and solar are subsidized, and they are growing in importance. The U.S. Department of Energy predicts solar power will represent 27 per cent of U.S. supply by 2050.

These developments, along with increasing efforts to enhance energy efficiency and conservation as well as renewable quotas and transmission constraints, influence both new supply and demand in Manitoba Hydro's target markets.

Growth in demand in the U.S. MISO market is not expected to be vigorous; the Brattle paper notes that demand growth will be very slow over the long term: around 1 per cent a year.

In addition, it is quite possible that there will be a significant reversal of existing anti-coal and climate policies of the administration of U.S. President Obama. This may arise from a collapse of the current climate change consensus, a return to a Republican administration or a Black Swan that forces a shift back to coal.

The return to coal has already occurred in parts of Europe and most obviously in Japan after the March 2011 tsunami caused meltdowns in the Fukushima Daiichi nuclear power plant and the effective transition away from nuclear power. The shutdown of nuclear in Japan has seen a resurgence of coal used for power generation and a build of new coal power plants.[23] In an electricity crisis, the U.S. Environmental Protection Agency would likely lose control over the supply side of the power system, and coal and gas would receive special treatment.

Such a scenario is possible even outside of a crisis if a pro-fossil fuel Republican president and Congress sought to rebalance the recent emphasis on restricting carbon and promoting renewables through subsidies.

Any of these developments would quickly diminish or even erase Manitoba's export markets, leaving Manitoba Hydro with a massive excess of supply that would lead to very low export prices and much higher Manitoba rates.

Manitoba's historical forecasts of demand growth

While decisions to invest in new hydroelectricity infrastructure were successful for Manitoba pre-Wuskwatim (2008-2012), current utility forecasts could be undone by new technologies, changes in society, enhanced efforts to conserve energy and reduce consumption, or technological innovation. This has happened before in Manitoba.

In an article from The Manitoba Historical Society, it was noted that in an earlier phase of forecasting future electricity demand...

> *"...[t]he power developments on the [Winnipeg] river had envisioned an even more rapid and continued expansion. … Consulting engineers planning Winnipeg's future water supplies in 1907 projected curves of anticipated population, and these in turn were used to make plans for the power needs of the future. The projections showed such close correlation with data from actual experience up to 1914 that it was confidently predicted that the [city's] population would exceed three-quarters of a million by 1948. It is interesting to speculate on the possible reasons for the error in these predictions. Professor Morton attributes the change in the growth rate of the province [a significant slowing down] to the building of the Panama Canal."*[24]

While a development at the other end of the continent was not the only factor that caused the forecasts for Winnipeg's electricity demand to be inaccurate, the situation illustrates how predictions can sometimes be inexact. In 1948, the actual population of the entire province was around 750,000. As of the 2011 census, the population of

the census metropolitan area of Winnipeg was 730,018, a figure that remains short of the forecast some 66 years later.

Forecasting may have become more complex, but it is still subject to human bias and prejudices. A number of general trends shaping the industry helps provide context to the proposed Keeyask and Conawapa dams and the Bipole III transmission line.

Electricity trends

As with Manitoba's electricity industry, there have been a number of phases in the broader sector. At present, three main issues require some explanation.

- **Declining Demand Growth:** The post-war period of expansion had large year-on-year growth of electricity demand. Throughout the 1990s and 2000s, the shift in demographics, industrial reorganization, green policies and more energy-efficient appliances meant that demand growth softened and progressively slowed. In Manitoba, the trend has not been as obvious as it is in the U.S. Midwest, which has been particularly hard hit by deindustrialization, demographic changes and investments in subsidized wind and solar. This does not auger well for future Manitoba and MISO-area demand.
- **Convergence of Electricity and Gas Markets:** As outlined in the previous section, electricity and gas markets have converged, making gas availability a driver of power prices. Again, the U.S. Midwest market with the tight gas from the Dakotas is evidence of this trend.
- **New Technologies:** Consumer products, solar panels, electric vehicles, cogeneration and new smart meters (time of use rates) have reshaped the electricity sector. The cumulative impact of these technologies has given consumers the ability to control and often reduce their power consumption. Grids have to accommodate household-produced power, often from solar panels, and may have to adjust to different demand patterns if EVs (which require charging) become more common. These broad changes may facilitate flattening of the demand curve and reduce or defer the need for new assets.

A death spiral?

The prospect of flat or declining demand is a scenario that is generally not considered by the electricity sector. It is comparable to the expectations of the U.S. housing industry prior to the Global Financial Crisis where prices were projected to always increase. Very few analysts anticipated and factored in a price decline for private dwellings. Suggesting that electricity demand will contract is met with disbelief, as it has never occurred and is not the experience of forecasters, who generally only predict increasing demand.

The east coast of Australia may offer a warning about the possibility of a decline in demand. This region has some similarities with the U.S. Midwest.

- A declining manufacturing base;
- Sluggish population growth, and in some areas, a net loss of people (similar to Detroit);
- Changing consumer preferences and greater self-imposed limits on electricity use; and,
- Aging assets that require major investments to continue the current levels of service.

Because of the above factors and increasing tariffs, economists at the Australian utility AGL came up with the "death spiral"[25] concept, where higher prices lead to lower consumption, which then lead to higher tariffs, and so on.

The United States was fortunate to have discovered the means to extract cheap feedstock (natural gas), but in a slow economy, the ability of consumers to reduce demand should not be overlooked. The United States is in the midst of an economic transformation. With Manitoba physically linked to the U.S. Midwest, how this region emerges from the economic changes will determine the end state of external power markets.

While Manitoba Hydro may have signed binding export contracts with U.S. utilities, there is no certainty that those contracts will be renewed. Yet, Manitoba Hydro's economic argument for expansion is predicated on profitable exports of all excess generation for 66 years (renewals of contracts on positive terms for Manitoba Hydro are, simply, assumed).

Conclusion

Planning and forecasting are very difficult. While Manitoba's domestic operations are insulated to some degree from some of the changes sweeping across North America, its export markets are not, and conditions in these markets will continue to change over the years.

7. Energy options for Manitoba: Pipe dreams or prudence?

Pipe dreams

The phrase "pipe dream" initially referred to the smoking of opium and the subsequent hallucinations that it produced. It emerged as a phrase in the U.S. Midwest around Chicago in the 1890s. This suggests that a period of rapid expansion and economic transformation encouraged the promotion of projects that would not stand up to normal scrutiny.

Merriam-Webster's online dictionary defines "pipe dream" as "an illusory or fantastic plan, hope, or story." It would be unkind to refer to Keeyask and Conawapa dams and the Bipole III transmission line as pipe dreams, as they are technically feasible, but they still pose some build challenges. However, the economics underpinning their development may place them closer to pipe dreams than to prudent investments.

Instead of recommending a particular course of action, it is better to look at the future of Manitoba's electricity through the prism of a number of choices or options. Some are quite radical and involve significant structural change to the incumbent government-controlled monopoly Manitoba Hydro. Others are simple, such as the option to do nothing. They should all be debated and considered, as there are billions of dollars of taxpayer funds at stake.

Despite the much-touted, expected electricity shortfall come 2022, there is no urgency to proceeding with the investment and build of Keeyask and Conawapa dams and the Bipole III transmission line. Even if there is an eventual decision to proceed with a megaproject, the opportunity to consider if current plans are prudent or a pipe dream remains. For assets with a life of half a century, a six to 12 month pause in plans is not critical.

The following options should be considered in any debate about the Keeyask and Conawapa dams, the Bipole III transmission line and the future of Manitoba Hydro.

Option One: Do nothing

Political and planning processes often demand action. This confusion of equating movement with progress often results in projects that develop a justification of their own, claiming vision and farsightedness in order to show the public that they are doing something. Given what is at stake in the development of the Keeyask and Conawapa dams and the Bipole III transmission line—with likely $2-billion having been spent ahead of regulatory approval, with perhaps another $8-billion to be spent or committed ahead of the expected 2016 election—it is still valid (both opposition parties have called for a suspension of the process around the new build and take more time to see if it is needed).

Recommendation: Halt the development of the Keeyask and Conawapa dams and the Bipole III transmission line and reassess in 12 months to determine if conditions justify the projects or if an alternative should approach be taken.

Option Two: Do not gold-plate

There can be many justifications for new network and plant investment. Some are more valid than others are. It is quite possible that some investments are not needed or at least not needed for some time. Engineers favour complex, large systems that are often built above specification. More accountability is needed for all electricity investments in order to moderate the ambitions of promoters of electricity projects that do not necessarily align with the needs of the province.

Recommendation: It is time that the concept of gold-plating entered the lexicon of Manitoba and is understood so that the public can be confident that its tax dollars are invested prudently.

Option Three: Consider natural gas

Similar in zeal to some religious fundamentalists, adherents of hydropower drive the debate over energy in Manitoba. Hydropower is certainly a good energy source and has a number of positive attributes, but it is far from being the only option. It is clear that Manitoba is fortunate to have significant hydro resources, but this does not mean that they are permanently the best choice for new generation plants.

Recommendation: If there is concern about the security of supply and a pending supply deficit within the province, consideration should be given to building a combined cycle gas plant, which would provide diversity of supply, which is an asset in the case of drought.

Option Four: Address conflict of interest

As a vertically integrated utility, there are inherent conflicts of interest within Manitoba Hydro.' Forecasting, building, managing, procuring and selling electricity result in internal processes that promote projects for reasons other than prudent investment. At various times, Manitoba Hydro is an exporter, a service provider and an indirect provider of welfare (via electricity-pricing formulas), as well as a supplier of power. These conflicts need to be identified and managed in order to determine a clear purpose and confidence in the organization and its internal processes.

Recommendation: The next Manitoba government should undertake a review into the conflicts of interest within Manitoba Hydro and make transparent the objectives then deal with any issues within a set time.

Option Five: Increase oversight

Based on the debates over the regulatory process of the proposed Keeyask and Conawapa dams and the Bipole III transmission line, it is clear that oversight needs to be extended. Given the complex regulatory and parliamentary processes, very few understand the technical language and dynamics of the requirements of an asset with a life span measured in decades. Regulators have to review a vast amount of data and make difficult decisions. Improving the independence (the members of the Public Utilities Board, the Clean Environment Commission and the Board of Directors of Manitoba) and increasing the resources of the Public Utilities Board (including a greater economic research capacity) would do much to improve public support.

Recommendation: There are many areas where oversight of Manitoba Hydro could be improved. It should be remembered that this entity exists to serve the province, not the opposite. The following initiatives to increase oversight and transparency should be considered.

- The Public Utilities Board (PUB) mandate should be enhanced to include the approval of major capital expenditures (capital expenditures drive electricity rates).
- Manitoba Hydro should not be permitted to include unapproved capital expenditures in its capital base.
- PUB members should be appointed based on knowledge and utility experience and with the support of all parties.
- Needs For and Alternatives To should have no restrictions with respect to what parts of Manitoba Hydro's proposed plans (and alternatives) would be subject to review.
- Mandatory benchmarking of all Hydro operations against international best practice should be introduced.

Option Six: Structural separation

There has been a great deal of debate over the privatization of Crown corporations. While there are benefits to private ownership of utilities, there is a solution that would keep ownership in government hands but force greater competitive tension: the structural separation of Manitoba along functional lines or geographical regions. Ideally, this would separate the procurement of electricity from new generation, so there are external solutions and options to forecast shortfalls.

Recommendation: To avoid the rancour over a privatization debate, the structural separation of Manitoba Hydro should be considered in order to create competitive tension in the provision (or need for) new electricity supplies. Options include the following:

- Split off the gas division, Centra Gas;
- Split off responsibility for division responsible for promoting energy efficiency;
- Allow for time of use rates, marginal rates for new and expanding industries; and
- End the monopoly of supply and remove the ability of Manitoba Hydro to restrict new entrants.

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Appendix

Electricity Market Overview for Manitoba Hydro's Export Market in MISO, an 84 page overview prepared for Manitoba Hydro, July 2013, accessible online.

Endnotes

1. The breakdown of Manitoba's history of electricity into two phases simplifies the numerous changes and developments that have occurred since March 8, 1873, when the Winnipeg Natural Gas Company incorporated. The creation of the modern Manitoba Hydro in 1961 is generally used in histories of this subject as a transition point. For examples of this overall framework (albeit in more detail), see L. Bateman, "A History of Electric Power Development in Manitoba" in *IEEE Canadian Review,* Winter 2005, p. 24.
2. This "big build" mainly occurred in the 1960s and 1970s and resulted in a large number of new hydro projects.
3. D.S.G. Ross, "History of the Electrical Industry in Manitoba" in *MHS Transactions,* December 31, 2012. Accessed online at http://www.mhs.mb.ca/docs/transactions/3/electricalindustry.shtml.
4. Bateman, L., "A History of Electric Power Development in Manitoba" in *IEEE Canadian Review,* Winter 2005, p. 24.
5. Hydro-Québec "Comparison of Electricity Prices in Major North American Cities." Accessed online April 20, 2014, from http://www.hydroquebec.com/publications/en/comparison_prices/.
6. Proponents of large, state-owned electricity utilities often point to the ability to plan over the long term and to access capital below comparable commercial rates as justification for maintaining existing structures. Advocates of this line of thinking underestimate the productivity improvements that can be gained through greater competitive pressures and a clearer purpose. Over the past 20 years, the lessons of disaggregating and privatizing electricity utilities have shown that the predecessor organizations were overstaffed, pursued projects that were not economical, and did not allocate capital optimally. A good example is the experience in Victoria, Australia. A report by the Institute of Public Affairs found "[t]he changes in the Victorian electricity sector have led to increased productivity of capital and labour, improved system reliability, freed up public capital, reduced public debt and reduced final prices." Institute of Public Affairs Ltd., "A Brief Analysis of the Benefits of Privatising Victoria's Electricity Industry," Energy Issues Paper Number 20, August 2001, p. 2.
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12. This refers to the ability of gas power plants to rapidly increase or decrease their electrical output. In comparison coal and nuclear power take some time (measured in hours or days) to increase or decrease electricity output.
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14. *Ibid.,* Slide 28.
15. Van Praet, N., "Is Québec's Electricity Business Model Broken?" *Financial Post,* March 1, 2014. Accessed online April 20, 2014, from http://business.financialpost.com/2014/03/01/is-quebecs-electricity-business-model-broken/?__lsa=6e56-4e3e.

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June 2013

Rolling the Dice on Manitoba's Future: The Unnecessary Gamble of Massive Hydro-electric Expansion

Graham Lane

https://www.fcpp.org/posts/media-release-rolling-the-dice-on-manitobas-future-the-unnecessary-gamble-of-massive-hydro-electric-expansion

February 2011

Energy Security 2.0

Gregory R. Copley

http://www.artofvictory.com/PDFs/Energy%20Security%202.0%20PDF%20Editi..pdf